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Ten Dollars for a Good Letter

The apprentice boy, on such roads as have adopted modern apprenticeship methods, is far more fortunate than his brother who received his training under the conditions that obtained more or less generally ten years ago. On the other hand, only a few roads have adequate apprenticeship systems to-day. If we are to encourage the best types of young men to enter the service we must make it as attractive as possible. How about the apprentice boys in your shop? Are they given a fair show? Do they receive systematic and adequate training in their trades? What help or encouragement do you give them? For the best practical statement contained in a letter of not more than 650 words on "How Can I Help the Apprentice Boys?" received before September 1, we will send a check for $10. Other communications which may be selected for publication will be paid for at our usual rates. Don't delay, but sit down and write a letter this evening.

Safety First in Railway Shops

In order that the best results may be obtained from the safety first propaganda in any railway shop, it is of paramount importance that the employees in that shop become so enthused with the idea that their enthusiasm will be evidenced, not by their words, but by their actions. A sign posted in one shop to the effect, "The greatest safety device known is the careful man," speaks volumes. With the best equipped safety devices known there are still loopholes for accidents, and these can only be prevented by educating the employees to be careful. Another excellent practice, which is followed by one road, is to post on a bulletin board a report of every accident that occurs, stating just what the accident was, the result, the condition of the patient and how the accident might have been averted. This appeals to the men through their desire for news concerning their injured comrades, and the postscript as to how the accidents could have been averted is likely to be remembered. Another good plan is to have the personnel of the local shops safety first committees changed frequently, in order that as many men as possible may become thoroughly familiar with the subject by having it brought constantly to their attention for the definite time they serve on the committee. Much has been done by the railroads in providing safeguards, but there is much more to be done in properly educating the employees.

The July Conventions

During the past month the General Foremen and the Tool Foremen met for their eleventh and seventh annual conventions, respectively. Both conventions were very successful. The General Foremen were favored with two noteworthy committee reports on subjects that were of vital interest to them, namely, Valves and Valve Gearing and Oxy-Acetylene Welding. The former occupied sixty-four pages of the advance papers and covered the field in a very thorough manner. Practically all phases of the subject were covered in a clear and concise manner and proved of such interest that the better part of two days was given to its consideration. Its true value will be more appreciated when the bound volume with the full discussion has been received by all the members of the organization and used by them at their individual shops in an endeavor to improve their shop output. F. A. Byers, chairman of the Committee on Oxy-Acetylene Welding, was exceptionally well fitted for that position, having become as thoroughly familiar with that work as perhaps any other member in the organization. The discussion on this subject took the question and answer form, Mr. Byers acting as the information bureau, and many problems were solved and the possibilities of this method of welding elucidated.

The Tool Foremen, in keeping with their past record, disseminated considerable information regarding the work in which

they are actively engaged. Several interesting special tools and methods for performing various shop jobs were mentioned, while there was also lively discussion on safety first. The association went on record as recommending standard reamers for locomotive frame and rod work, something that has long been sought by both the railroads and the manufacturers. As the matter now stands, with no standards for these long and expensive reamers and with scarcely no two roads ordering the same style of reamers, it has been necessary for the tool manufacturers to charge special reamer prices. By the tool foremen getting together and agreeing to a standard, which, from their deliberations, they believe to be the best all around reamer for frame and rod work, they have accomplished something which, if the standards are adopted by the railroads, will be of benefit to all.

A Car Department Competition

"Car inspectors and car foremen very often have valuable ideas, but they have been made to feel for so long that they are of minor importance in a railway organization, that it is hard to get them to talk about them." So writes one of our correspondents. We don't want them to feel that way and have, therefore, arranged a competition especially for their benefit. There are not many jobs on a railroad that require more intelligent and thoughtful effort than that of the car inspector, and the job carries with it, as well, a considerable amount of responsibility. The interchange rules have gradually grown in number until they are almost hopelessly complicated. In looking over them it would seem almost necessary to have a college graduate to comprehend them. Where do the men come from who inspect the cars to see that these rules are lived up to? How were they developed? What special training did they receive? What qualities must they possess? What opportunities are open to them for advancement? These questions have given car department heads great concern for many years. We will give a prize of $35 for the best article on "How Should Car Inspectors Be Trained and Developed and What are Their Qualifications?" which is received in our office, Woolworth Building, New York, on or before October 1, 1915. Such other articles as are accepted for publication will be paid for at our usual rates. The judges will base their decision on the practical value of the suggestions which are made.

The Supplyman at Conventions

The railway supplyman, with his exhibit, is a welcome feature at the annual conventions of the mechanical department associations. Sometimes, however, he behaves himself in a most awkward manner. It was suggested by an observer at the opening session of one of the recent conventions that the supplyman might profit greatly if a code of ethics could be developed to guide him in his conduct on such occasions. At the time the remark was made the room was crowded for the invocation and address of welcome. The president had worked hard during the year to make the convention as instructive and effective as possible, and was down on the program to follow the address of welcome with the presidential address. He had spent a great deal of time in studying the progress of the association in order to incorporate some pertinent suggestions for its future welfare. His face was a study when, as he arose to read the address, a large number of supplymen began to slip away into the exhibit rooms. Was it common courtesy? Was the president not the chosen representative of his fellows, and was it fair to him or to them to turn their backs on him in this way? It is well known that he had done much to develop and enforce methods of having the members systematically visit and study all of the exhibits. Had the supplymen forgotten this? Could they not have well afforded to spend 15 or 20 minutes in the meeting room even if they felt that they were not specially interested in the message which was to be given? Can any railway supplyman afford to ignore the technical proceedings of an association whose guest he really is? We believe—we know—that the exhibts are a most valuable adjunct to the mechanical department conventions, but if those in charge of the exhibits do not understand some of the fundamental principles of common courtesy, will it not do much to hurt the entire supply fraternity?

Consolidation of Mechanical Associations

President Scott, in his opening address before the General Foremen's Association, went on record as favoring some such consolidation plan of the railway mechanical associations as that proposed by F. F. Gaines in his presidential address at the Master Mechanics' Convention, and recommended that the chairman of the executive committee confer with the executive committee chairmen of all other mechanical organizations for the purpose of devising some plan by which such a consolidation can be made. This would seem a most logical plan to follow, and if the idea meets with the approval of the other mechanical organizations considerable headway could be made within the next year toward working the plan to a successful conclusion. It cannot be questioned that a supervisory control of the several railway mechanical associations would be beneficial to the associations themselves and to the railways, for, as Mr. Scott says, "It means that the minor associations will receive more helpful recognition from the larger associations, which will lead to a better understanding and closer co-operation along the lines of economy and the standardization of locomotive parts and appliances."

An excellent example of the beneficial results that would accrue from such a consolidation is shown by the Tool Foremen's Association. At its last convention it recommended standards for frame and rod reamers. The tool foremen realized the need of such a standardization and have worked hard and drawn up recommendations that represent the best average reamers for the work involved. Under the present arrangement the question arises: "What will be the result of these recommended standards?" With a consolidation of the association these recommendations would automatically be presented to the proper body for definite action and the work of the tool foremen would not have been in vain.

There are several other arguments in favor of consolidation or supervisory control: It would eliminate considerable duplication of effort; the subjects for discussion would be more logically chosen; a better attendance would be assured at the conventions and more definite results would be obtained by the various craftsmen thus convening. There is food for considerable thought in Mr. Gaines' recommendation, and it should receive very careful consideration from all the mechanical associations.

Sufficient and Competent Supervision

"The greatest factor in effecting and maintaining shop efficiency is *competent supervision,*" is the opening sentence in George H. Logan's report on "Shop Efficiency" presented to the General Foremen's Association at its recent convention. Mr. Logan hit the nail squarely on the head. Competent supervision is necessary throughout the entire mechanical department, and "competent" means that the supervisors should not only be well qualified for their positions, but that there should be enough of them to thoroughly cover the field. The railway supply concerns have not been slow in developing labor-saving and economical devices for use on locomotives and cars and in the shops, nor have the railways been unduly slow in adopting them; but human intelligence is necessary in their use, and this cannot be manufactured.

With all the improved machinery, tools and locomotive attach-

ments the best results cannot be attained unless the men using these improvements are educated to get the most out of them. This is self-evident, and railways have to a certain extent assigned special men to the definite work of educating employees, with very gratifying results; but this work has not been carried to anywhere near its limit. There is still need for more of these "teachers," who, when logically selected and assigned, will produce results that will pay their salaries many times over. What has been accomplished by supervision and education in the use of fuel has been referred to many times in these columns, and it is claimed by several experts who are actively engaged in this work that much better results can be obtained with a larger force of supervisors. Almost every railway shop has a demonstrator who educates the workmen in the proper method of handling the machine tools. A few roads employ traveling car foremen, whose duties are essentially to educate the car repair men regarding the billing of repairs to foreign equipment and the M. C. B. rules of interchange—a very important matter that every road should carefully supervise. The Safety First committees find that their most important duties are to educate the men to be careful. The tool foremen claim that better supervision in the grinding of tools will materially increase the shop efficiency.

And thus it goes; examples without number could be mentioned where supervision, and enough of it, will be a most profitable investment for any road. The education of employees regarding the correct methods of doing their work is of fundamental importance, and to properly educate them a proper supervisory force is necessary. The cost of this force will, of course, increase the overhead expenses, but if the men are properly chosen the returns in increased efficiency will warrant the expenditure.

Prevention of Engine Failures

"Perfect organization in an enginehouse is the cure for engine failures." In considering this statement, which was made at the convention of the International General Foreman's Association, held in July, in Chicago, let us determine first what may be fairly said to constitute a perfect enginehouse organization. Such an organization would accomplish the coaling, watering, fire-cleaning, housing and repairing of locomotives in a minimum time, at a minimum expense with a minimum amount of friction, and the work would all be done in such a manner that no after trouble would arise from it. Even granting the possibility of producing such an organization, it by no means follows that engine failures would be eliminated. The enginehouse can go a long way toward preventing failures, but the other branches of the mechanical department must do their full share if they are to be eliminated or the number greatly reduced.

It might be said that the prevention of engine failures should begin with the locomotive design; proper attention given to the conditions under which the engine is to operate will do much to prevent trouble of this kind. But considering the engines already in service, the place to begin the prevention of engine failures is the general repair shop. Back shop repairs, if carelessly or improperly made, will result in engine failures in spite of efficient enginehouse organization. We frequently hear it said that a certain shop has an output of so many engines per month and as a means of arriving at the *quantity* of work which the shop is doing the monthly output of engines may be satisfactory; but what about the *quality* of the work? How long do the engines stay out after they are repaired? They may stay out of the main repair shop the full twelve months, or whatever the time is between shoppings, but what is it costing the railway company to keep them out of the main shop for that length of time? The repair work has got to be done somewhere if the locomotives are to give reasonably satisfactory service, and if it is not done in the main repair shop it has got to be done in the enginehouse, which is saddled with much of the blame for engine failures which should be placed at the door of the man in charge of the main repair shop.

The quality of the work done in the main shops in making general repairs to locomotives then has a very considerable bearing on the number of engine failures. And still another feature with which the enginehouse has no connection, and which, nevertheless, adds its quota to the engine failure record, is the method pursued in handling the locomotives on the road. On the kind of man employed as road foreman of engines depends largely the extent to which the failure record will be affected in this way. If he is a man who takes a direct interest in his work and in those under him he will see that enginemen and firemen work in harmony to get the most out of a locomotive with the least trouble, and that his men are so instructed in the carrying out of their work that they will prevent steam failures and failures due to leaky tubes so far as is in their power. There is, of course, a certain percentage of engine failures, such as those due to poor coal or to failures of material, which will probably never be entirely avoided, but by far the greater number of failures are avoidable, and, in fact, many of them should be considered a disgrace.

It seems to be popular in some quarters to place the blame for all engine failures on the enginehouse; in fact we have heard a master mechanic state that he considered enginehouses to blame for at least 99 per cent. of the engine failures on his road. With this statement and with the one quoted above, we cannot agree. The enginehouse can do a great deal to prevent engine failures, but unless the locomotives receive back shop repairs of the proper quality and are given the care and attention which they deserve at the hands of the crews operating them, there is a limit in the prevention of failures beyond which an enginehouse organization cannot go, and beyond which the responsibility for failures should not be placed upon it.

NEW BOOKS

Proceedings of the Master Tinners', Coppersmiths' & Pipefitters' Association. Compiled and published by W. E. Jones, secretary of the association, Chicago & North Western Railway, Chicago, Ill. 83 pages, 6 in. by 9 in. Bound in paper.

This book is the report of the second annual convention of the American Railroad Master Tinners', Coppersmiths' & Pipefitters' Association, and contains papers on Oxy-Acetylene Welding, Shop Efficiency, Alloys and Their Uses, Tin Roofing vs. Canvas Roofing and Specialized Training.

Experience in Efficiency. By Benj. A. Franklin. 167 pages, 5 in. by 7½ in. Bound in cloth. Published by the Engineering Magazine Co., 146 Nassau St., New York. Price $1.00.

A few weeks' study of the tendency of the workmen in a certain factory resulted in a saving of $30,000 a year. None of this money was spent for new equipment and no changes were made in the organization; there was simply a correction made of the wrong conditions. The author of this book tells of some of these wrong conditions, what they actually were and how he found them. The book shows the shop employer or manager who is in difficulty with the problems of increased cost of production and diminishing returns, how success has been worked out by others under similar conditions. The material in the book is collected from the author's experience and while reduced to its simplest elements still shows the character of the problems attacked and the nature of the solutions found. Four chapters are devoted to methods of increasing both output and the quality of direct production; the fifth chapter extends the same principles to the treatment of clerical or non-productive labor and the sixth enlarges the same idea so as to include the entire force. The seventh chapter leaves the individual and takes up the matter of organization while the eighth attacks the problem of reduction of factory expenses.

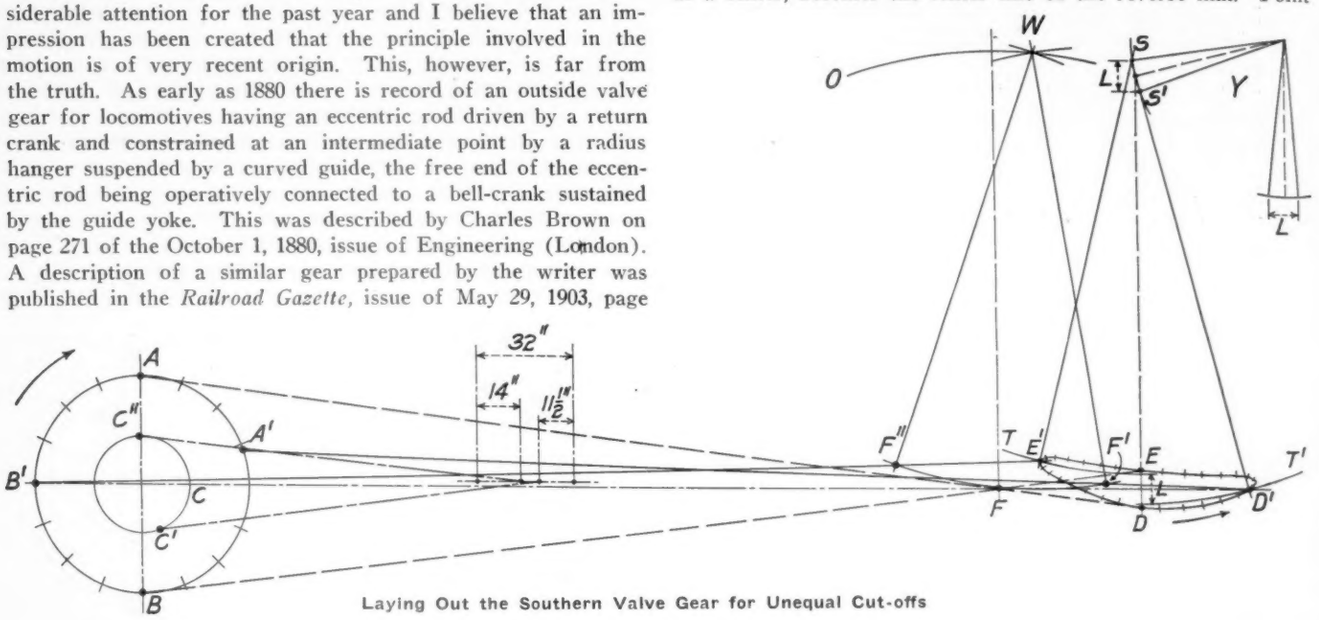
COMMUNICATIONS

LAYING OUT THE SOUTHERN VALVE GEAR

LOUISVILLE, KY.

TO THE EDITOR:

The Southern locomotive valve gear has been attracting considerable attention for the past year and I believe that an impression has been created that the principle involved in the motion is of very recent origin. This, however, is far from the truth. As early as 1880 there is record of an outside valve gear for locomotives having an eccentric rod driven by a return crank and constrained at an intermediate point by a radius hanger suspended by a curved guide, the free end of the eccentric rod being operatively connected to a bell-crank sustained by the guide yoke. This was described by Charles Brown on page 271 of the October 1, 1880, issue of Engineering (London). A description of a similar gear prepared by the writer was published in the *Railroad Gazette*, issue of May 29, 1903, page 377. Following the gear disclosed by Mr. Brown we have had the Marshall, Bremme, Klug, Wyllie, Strong and finally the Southern gears, all kinematically one and the same.



Laying Out the Southern Valve Gear for Unequal Cut-offs

Referring to the Marshall gear a statement is made in the International Text Book Company's volume on steam engine and boiler design to the effect that no definite rules for its layout can be given. The following direct method of determining the length of the radius hanger and the radius of the curved guide will be of interest.

It is well known that in order to equalize the amount of work done by the two ends of the cylinder, it is necessary to maintain a higher mean effective pressure in the crank end than in the head end, which may be done by providing a later cut-off in the crank end. The diagram shows a method of laying out the Southern valve gear in order to obtain this effect, the diagram being constructed on the assumption of a working cut-off of 11½ in. at the head end and 14 in. at the crank end. Starting with the bell-crank *Y*, this is shown in the two cut-off positions, the distance *L* being equal to twice the steam lap on the inside admission valve to which it is directly connected. With *S* and *S'* as centers the arcs *T* and *T'* are then struck with a radius equal to the length of the transmission yoke. With the crank pin at *C'*, which is its position for a cut-off of 11½ in. in the head end, the eccentric crank will be at *A'*. The eccentric rod is then laid in position *A' F' D'*, the latter point being the intersection of the loci of the free ends of the eccentric rod and the transmission yoke. With the crank pin at *C''*, which is its position for a cut-off of 14 in. in the back end of the cylinder, the eccentric crank is at *B'* and the eccentric rod has position *B' F'' E'*.

Points *D* and *E* on the ellipse are fixed by the lap and lead of the valve, the distance between them being equal to twice the lap plus twice the lead. With the crank pin then placed successively on the two dead centers, the eccentric crank will be located at *A* and *B* respectively, the eccentric rod occupying the position *AFD* and *BFE* respectively, intersecting at point *F*, which determine the location of the radius hanger connection. With the distance of this point from the end of the rod determined, the points *F'* and *F''* showing the location of the radius hanger connection for the two cut-off positions may be located.

Determining the length of the radius hanger and the radius of the reverse link is now in order. The length of the radius hanger is determined by locating a point, *W*, which is equidistant from points *F'*, *F* and *F''*, the distance *WF* being the required length of the hanger, and the arc *OW*, struck from the point *F* as a center, becomes the center line of the reverse link. Point *W* is the position of the link block center in the working cut-off under the conditions assumed.

In order to avoid the erasure of trial arcs in determining the point *W* a piece of transparent paper or tracing cloth may be placed over the drawing to good advantage while doing this work.

HARRY CORNELL.

WATER IN COAL MINES.—For every ton of coal raised from one of the anthracite mines, the operators of that field are obliged to pump to the surface about eleven tons of water. It is estimated that in the anthracite mines there are 900 pumps in use at the present time. The capacity of these pumps is approximately 1,000,000 gal. a minute.—*American Machinist.*

EFFECT OF SPEED ON GRINDING WHEEL WEAR.—Grinding wheels appear softer at slow speed because the metal being ground tears the grinding particles away from the bond which holds them together. Don't condemn a wheel as being too soft until you are sure that its cutting speed is correct.—*Iron Trade Review.*

STEAM VELOCITY IN PIPES.—The velocity of steam in pipes commonly allowed for medium and high pressure is 6,000 to 8,000 ft. per min., but the tendency of the present is toward much higher velocities (even to double the figures given), especially where considerable initial superheat is given the steam.—*Power.*

SMOKE CRUSADE ABANDONED IN BALTIMORE.—That the smoke crusade in Baltimore has been a failure and that the smoke abatement commission has done little or nothing, is the statement made by Mayor James H. Preston of that city. Several months ago the smoke inspector, dissatisfied with the progress of the commission, tendered his resignation, but it was not accepted. It is believed now that it will be accepted and that further efforts on the part of the city to abate the nuisance will be abandoned.—*Iron Age.*

How Do You Select Your Men?*

Simple and Practical Suggestions Looking Toward the Solution of a Most Difficult Problem

BY ROY V. WRIGHT

Possibly no one problem is of greater importance to the railway executive or industrial manager than that of knowing how best to select men either to enter the organization at the bottom or for promotion to more important positions. We can analyze the properties of materials and predict their performance under given conditions with more or less accuracy. The human element, however, which controls the use of these materials and is by far the most important factor in determining the efficiency of operation of a manufacturing plant or a railway property is far more difficult to analyze and direct with a view to securing maximum efficiency. The necessity of giving greater attention to this element has become more and more evident in the intensive development toward greater efficiency which has been so marked during recent years. The selection of men is such a complicated problem, however, that many executives have gone on as best they could feeling that science could contribute little toward its practical solution.

Vital as is this problem to a manufacturer or industrial plant, it is far more important to the railway with its forces scattered widely and with the higher executive officers, and many even of the minor ones, unable to keep in close or intimate touch with their subordinates.

In attempting to solve the problem of the selection of men some have looked to experimental psychology, such as is exemplified in Professor Hugo Munsterberg's work and particularly as outlined in his book on "Psychology and Industrial Efficiency." Others have looked into the theory of phrenology, feeling that possibly it might be used to determine the characteristics of different individuals with a view to seeing whether they were fit for promotion or whether by this means men could be selected with any degree of success for performing certain specific classes of work. Then we have had the theories of Dr. Katherine M. H. Blackford, which take into consideration certain physical characteristics, including color (blond or brunette), shape and profile of head, size, structure, texture (fineness or coarseness of fibre or grain as seen in the hair. skin, nails, features, hands, feet and general body build); consistency (hardness, softness or elasticity of bodily tissues), proportion, expression and condition of body, clothing, etc. Dr. Blackford it was who placed special emphasis on keeping three things in mind in selecting a man for a job: First, the type of job; second, the characteristics of the man himself, and third, and possibly equally important, the characteristics of his boss. Some of the claims which are made for this science of character analysis are defined in an advertisement in one of the recent numbers of a popular magazine in the following words:

> In this course you learn to judge others quickly and accurately. You learn to know what a man's appearance means—his face, his head, his hands, his eyes, his expression, his walk, his handwriting—everything about him. You do not measure his head or ask him questions or let him know in any way what you are doing. There are no repetitions, no theories, but a clean-cut presentation of the principles underlying human character—with so many photographs, diagrams and charts that you can learn and apply the principles rapidly and easily, etc., etc.

Of how much value are all of these things? How much reliance may be placed upon them? If they are not satisfactory or reliable, is there any practical way of selecting a man for a job or for promotion with a fair degree of certainty as to his fitness for the position? The remainder of this brief talk will be devoted to answering these questions.

Most of you have undoubtedly heard of Dean Hermann Schneider of the University of Cincinnati, and possibly some of you are fortunate enough to have had the pleasure of meeting and becoming acquainted with him. He it was who first put into effect in a big way the idea of having practical and theoretical training go hand in hand in engineering education, by securing the co-operation of the machine tool builders and manufacturers of Cincinnati with the university, and in establishing the co-operative engineering courses. The wonderful results which followed this experiment make a long story and doubtless are familiar to many of you. Suffice to say here that the results were so eminently practical and so striking that in one form or another the methods are rapidly being extended far and wide, both in connection with engineering courses, in colleges and universities which are so located as to be able to secure the co-operation of industries, and also in many lines of industrial and vocational training throughout the country.

As a concrete example, let us consider what happened in one large department store. Those in charge felt that the sales force was not doing its best work because the employees were not properly trained, either in general education or as to their knowledge of the merits of the products which they sold, to deal to the best advantage with the leading people of the city who did their shopping in the store. Manifestly there are certain times during the day when it is not necessary to have all of the sales force on duty. Arrangements were made with the city school system to provide instruction during these periods, to those who could be spared, in English, civics and other studies which would develop the employees into bigger and broader men and women and make better citizens of them. Then, too, the employer, who provided and fitted up the schoolroom, saw to it that expert instruction was given in the methods of manufacture and as to the merits of the different products which were sold.

The latest development along this line is the general vocational training movement which is spreading throughout the country. New York City, for instance, has gone into the matter on a large scale and has retained Dean Schneider as one of its chief advisers. In the Woolworth Building, where our offices are located, the representatives of the city school system have made a canvass to find whether a sufficient number of employees can be spared at different times during the day to warrant the fitting up of a school-room and the providing of instruction in the building. At the shops of the Baltimore & Ohio on Staten Island the city is co-operating by providing instruction to the apprentices, the railroad furnishing the schoolroom—an old passenger car—and the Board of Education of the City of New York paying the salary of the teachers, who in this particular case are employees of the railroad, and also for the material used.

I have outlined this development thus fully, not because it has any special bearing on the subject under discussion, but because I want you to have some idea of what Dean Schneider has done and of that for which he stands. He is a man with a hobby, but he is big enough to see over and around it. He has a keen and analytic mind and is capable of sizing a problem up from a broad and liberal viewpoint. He has a splendid supply of patience and is absolutely unselfish in his efforts to help others.

In connection with the work of the co-operative engineering courses at Cincinnati, which have been carried on for a num-

* An address given at a luncheon of railway officers at the Auditorium Hotel, Chicago, Tuesday, June 29, under the direction of the General Railroad Committee of the Chicago Y. M. C. A.

ber of years, Dean Schneider and his associates have come in contact with hundreds of young men whom they have had an opportunity of studying critically and whose progress along both practical and theoretical lines they have been able to observe and follow closely. Because of the nature of the work, the students spending alternate weeks in the manufacturing shop and in the class-rooms at the university, the instructors and shop co-ordinators can get closer to the students and know them more intimately than under the usual conditions. Moreover, they have been able to follow many of these men after they left the institution and to observe their progress.

As stated by Dean Schneider in a paper entitled "The Problem of Selecting the Right Job," which was recently presented before the third annual convention of the National Association of Corporation Schools, "one leg of the tripod upon which the co-operative system of education rests is the selection of men for the work for which they are to be trained." The university authorities, on the basis of their study and observation of the individual students, now guarantee to Cincinnati manufacturers for certain jobs men who have finished three years in the co-operative course.

In the effort to determine whether phrenology, physical characteristics or applied experimental psychology had any merit in such selection, a great number of experiments were made on mature students whose characteristics and qualities were well known, but not by those actually conducting the tests. The tests demonstrated conclusively that these systems were not at all reliable and that the only practical and successful way of selecting men is by testing them out on the actual job.

Concerning the tests as to physical characteristics Dean Schneider stated: "This seems to be a development of the old idea of phrenology. It is claimed in this system that physical characteristics indicate certain abilities. For example, a directive money-making executive will have a certain shaped head and hand. A number of money-making executives were picked at random and their physical characteristics charted. We do not find that they conform at all to any law. Also we found men who had the physical characteristics that ought to make them executives, but they were anything but executives. A number of tests of this kind gave negative results. We were forced to the conclusion that this system was not reliable."

As to applied experimental psychology the Dean had this to say: "The science of applied psychology seems to be at the point where chemistry was when it was alchemy; we may hope, however, that Illusion is the First Appearance of Truth."

It is not my intention, and I very much doubt if it was Dean Schneider's intention to unqualifiedly and wholly condemn these things. It is quite possible that they may contain certain elements of truth. The trouble is that they are being carried to a ridiculous extreme. If on the other hand they are instrumental to some degree in awakening executives to the importance of the problem, they will have served a useful purpose.

Dean Schneider finally concludes, on the basis of the study and testing of about 1,000 mature students, both in theoretical and practical work, that: (1) A worker's failure is as significant as his success and should be analyzed to indicate a new and fitting job; (2) the characteristics developed by analysis of many successes and failures furnish a basis for placement which works better than any plan we know; (3) the method is crude and unscientific; it requires a period of time much greater than other methods proposed, but it insures a reliable verdict.

Knowing of the man and his work as we do, we are pretty safe in accepting his conclusions. Doubtless they agree fairly closely with those of many in the audience who, however, have not been in a position to prove their correctness, not having had the exceptional opportunities for observation possessed by Dean Schneider.

On these conclusions as a basis, how can we go ahead logically to induce the supervising officers to study more critically the characteristics and work of the men who enter the service, with a view to determining whether they are properly fitted for the tasks to which they are assigned? It would seem that in hiring men the initial selection should be made by members of the organization who have some special ability in sizing men up; then if they are closely watched and given a thorough trial on actual work, it should be possible to determine within a reasonable time whether they are the sort of men that will prove satisfactory and along just what lines it will be best to develop and train them.

The trouble under present methods is that a new man taken into the organization is in most cases not given any systematic attention. If he is very bad he is fired. If he is passably good he is allowed to remain, but no one knows with any degree of certainty whether he is the best man for the job, or whether he is capable of doing better work or not.

A simple method of checking the personality and performance of these new recruits will be described. It was not developed and used especially for that purpose, but is admirably adapted to it, as well as for checking men already in the service with a view to determining whether they are properly placed, along what lines they can best be developed and just which ones are best suited for promotion to more important positions. It has been tried out on a large scale with splendid results and is inexpensive to install and maintain. It cannot be successfully inaugurated or followed up, however, unless it has the enthusiastic backing and support of the higher executive officers.

Briefly, the scheme is as follows: Each foreman or supervising officer is provided with a sufficient number of special report cards to cover each one of his immediate subordinates, which he is required to fill in and return to his superior officer. He is not expected to keep any copy of these reports and is called upon at periods, of say six months, to make similar reports on each man. The comparison of the reports for any individual will show whether he has made progress in improving his weak points. If he has not, or has apparently fallen behind, his superior is asked for an explanation and is held responsible either for failure to properly train and develop the man or for lack of accuracy in sizing him up. In this way the foreman is automatically compelled to study his men more closely, and the effect in improving and developing the executive ability of such officers is a most noteworthy feature.

The characteristics upon which a report is made are such as to indicate a man's fitness for holding a position in the organization and as to whether he is worthy of promotion. The items on a report card,* which was used by LeGrand Parish, with standard and concise definitions, are as follows:

EDUCATION: Mental and moral training.
SPECIAL KNOWLEDGE:
EXPERIENCE: Knowledge acquired by actual trial and observation.
HONESTY: Upright disposition or conduct.
MORALITY: Accord with the rules of right conduct.
TEMPERANCE: Moderation.
TACT: Ability to do or say what is best for the intended effect.
RESOURCE: Good at devising expedients.
RELIANCE: Sure dependence.
FORESIGHT: The act or power of foreseeing.
APPEARANCE: Outward look or aspect.
MEMORY: Mental hold on the past.
ENERGY: Active, effective.
INITIATIVE: The ability or disposition to take the lead.
PERSISTENCE: Steady or firm adherence to, or continuance in a state, course of action, or pursuit that has been entered upon.
ASSERTIVENESS: Affirming confidently, positive.
DISCIPLINE: To teach rules and practice and accustom to order and subordination.
PROMPTNESS: Quickness of decision or action.
ACCURACY: Correctness.
SYSTEM: Regular method or order.
ORGANIZATION: A systematic and regulated whole.
EXECUTIVE ABILITY: Ability to carry into effect in a practical manner.

* For more complete description of this card see *American Engineer and Railroad Journal*, December, 1908, and *Railway Age Gazette*, July 23, 1915, page 151.

A man is graded, as very good, good, medium or poor in each of these characteristics.

This scheme eliminates the "hit and miss" method of selecting men for promotion and was instrumental in locating suitable men with considerable accuracy. Too often when it comes to promoting men a decision is based on the man's recent performance, when he may have done some spectacular piece of work which placed him in the limelight but which may not give any indication of his fitness for holding an executive position. The men throughout the organization, understanding that these records were being kept, were encouraged to improve and better themselves. Men who were unsuited for the work to which they were assigned were discovered and transferred to tasks for which they were better fitted, or if they were found hopeless, were eliminated from the organization.

These report cards were developed ten years or more ago and remained in use several years until Mr. Parish left railway service—long enough to demonstrate their value beyond question. In the light of experience it was Mr. Parish's idea to revise the characteristics, including some which are not shown in the list quoted and eliminating or changing others.

It so happens that Dean Schneider, in making his observations, employed record cards of a somewhat similar nature, but possibly of a broader scope and more closely approximating the ideal toward which Mr. Parish was working. The characteristics noted on Dean Schneider's records were as follows:

Physical strength, or physical weakness. In some occupations physical strength is essential; in others it is not.

Mental, or manual. This may be stated in another way and in rough terms as "head efficiency" as compared with "hand efficiency."

Settled, or roving. Some men work best under a steady routine; others like to move about and see or do new things.

Indoor, or outdoor. Some men thrive best under outdoor work; others prefer indoor work.

Directive, or dependent. Some men assume responsibilities; others evade them.

Original (creative), or imitative. Some men are fertile in making suggestions; others do not possess this quality but are good at putting them into effect.

Small scope, or large scope. Some men like to fuss with intricate bits of mechanism; others want tasks of big dimensions.

Adaptable, or self-centered. The first might make a good salesman; the second a statistician.

Deliberate, or impulsive.

Manual accuracy, or manual inaccuracy.

Mental accuracy (logic), or mental inaccuracy.

Concentration (mental focus), or diffusion.

Rapid mental co-ordination, or slow mental co-ordination. Some men go to pieces in an emergency, whereas if they were given time to consider the situation they hold together and act wisely.

Dynamic, or static. One man may lack push or determination; others having the dynamic quality possess these characteristics.

Little has thus far been said as to the necessity for providing some adequate means of training the men in all of the departments. Its importance immediately becomes apparent in developing a system such as that outlined above. That it pays generous dividends is indicated on such roads as have installed modern apprenticeship systems for mechanical department employees, or have developed educational campaigns for improving conditions and securing greater efficiency or economy in other departments. It is unfortunate that more attention is not being given to this subject by railroads generally.

In this connection allow me to quote a few paragraphs from an address on "Training of Young Men with Special Reference to the Question of Promotion,"* which was given by George M. Basford before a recent meeting of the Burlington Association of Operating Officers.

"To-day we are looking for the genius and are overlooking the production of good workmen. We are depending upon officers. We need to depend upon men. Trained, properly educated and encouraged workmen will provide good officers later.

"Systematic methods of selecting human material for the organization are imperative. The boys in offices, in shops, and all along the road should be most carefully and intelligently selected. Someone well qualified must be given this responsibility. Then these recruits must be tried out, and those 'making good' must be trained. This word 'trained' represents a new meaning as applied in this connection. It means thorough education of hand and brain and conscience.

"Because of the size of a railroad organization it is necessary to provide easy and automatic methods of discovering ability. It is desirable that promotion should be proposed by co-operative action by subordinate officials and controlled by a very high official whose authority is complete in this case. Suppose the president of a railroad could find a man qualified for the duty of directing the training and promotion of men. The difficulty in finding such a man emphasizes the importance of the duty. This man should be given a dignified, powerful position, with such a title as Assistant to the President. He should be responsible for methods of recruiting, methods and means of training men, and for a scheme whereby he will personally know that every promotion is based upon merit, with favoritism and politics banned. He should be responsible for and personally approve every promotion in the entire organization."

Mr. Basford then describes the report cards which were used by Mr. Parish, and among other things concludes: "Our Assistant to the President need not personally watch all these cards. He should, however, by frequent checks know positively that every department head is watching them, and he should personally keep the records of all important officials. He should also require record cards for a long period to accompany a recommendation for promotion. For example, a vacancy as assistant superintendent is to be filled. The Assistant to the President would call on all interested departments for recommendations and the office would be filled after an intelligent and complete investigation of all eligible men, including the mechanical and track as well as the operating department. The plan should cover every department."

The scheme suggested by Mr. Basford, if put into effect, would do much to make positions on the railroad more attractive to ambitious young men and would undoubtedly develop means for locating such men in the territory served by the road and of getting them to enter its service.

In conclusion the point which I especially wish to make is that it is imperative from the standpoint of future efficiency and economy that each organization should formulate and adopt a policy, which will have the hearty support and backing of the executive officers, as to the selection of men for the different jobs; the proper training of these men in order to make their efforts as effective as possible, and a comprehensive method of selecting men for promotion. If this is done—and it is not a matter which can be accomplished in a week, a month or a year—it will not only increase the efficiency of each individual in the organization to a maximum, but it will encourage loyalty on the part of all of the employees and develop an *esprit de corps* which will do much to eliminate friction and labor difficulties and will place any organization which possesses it in an enviable position as to efficiency and effectiveness.

*For full text of address see *Railway Age Gazette*, July 23, 1915, page 15.

RECIPROCATING AND REVOLVING PARTS

BY H. A. F. CAMPBELL*

III.—British Design

Through the courtesy of the mechanical department officers, the writer has received drawings showing the details of the reciprocating parts used on some of their latest locomotives. Lack of space will prevent showing all the designs; this is to be regretted because each is worthy of careful study. Table XII, however, gives the detail weights of the reciprocating parts of six English engines. The weight of each part per unit of load carried has been worked out as was done in tables I to V for American locomotives. It will at once be seen that the weights per unit of load are far in advance of our regular practice and indeed are right up to the figures obtained on those American engines where special care was used to reduce the weight and already shown in Part I.

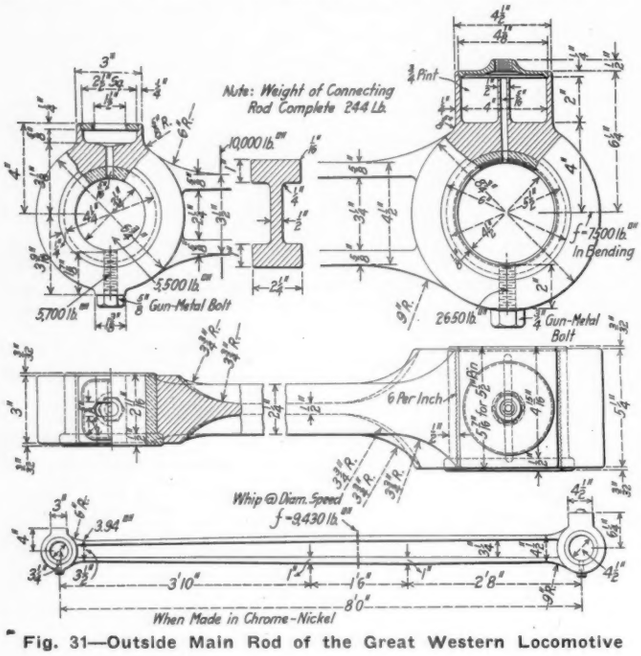


Fig. 31—Outside Main Rod of the Great Western Locomotive

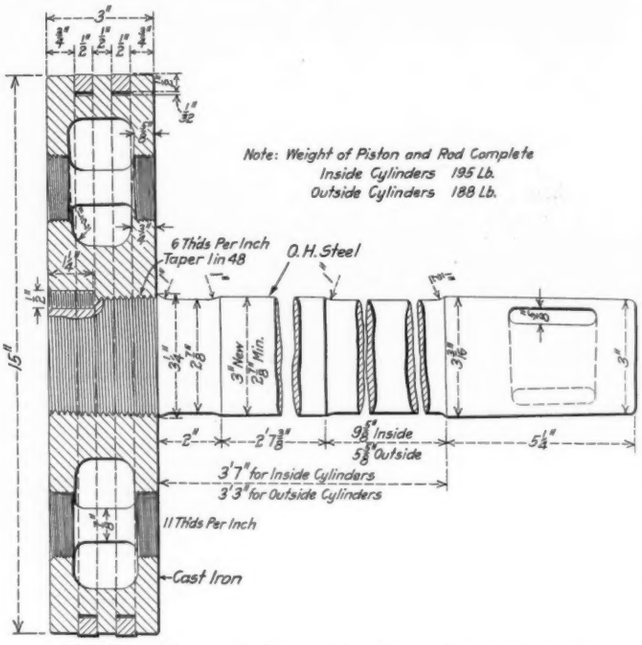

Note: Weight of Piston and Rod Complete
Inside Cylinders 195 Lb.
Outside Cylinders 188 Lb.
6 Thds Per Inch Taper 1 in 48
O.H. Steel
11 Thds Per Inch
Cast Iron
3'7" for Inside Cylinders
3'3" for Outside Cylinders

Fig. 33—Piston and Rod of the Great Western Engine

Considered as a general average, these stresses are very little, if any, higher than the stresses in regular use in America. With one exception the steel is the regular open-hearth carbon of 80,000 lb. per sq. in. ultimate strength, although it is the Siemens-Martin acid steel and not basic steel. The reduction in weights, then, cannot be said to be due to the use of special steel, nor to the use of higher stresses. The saving in weight

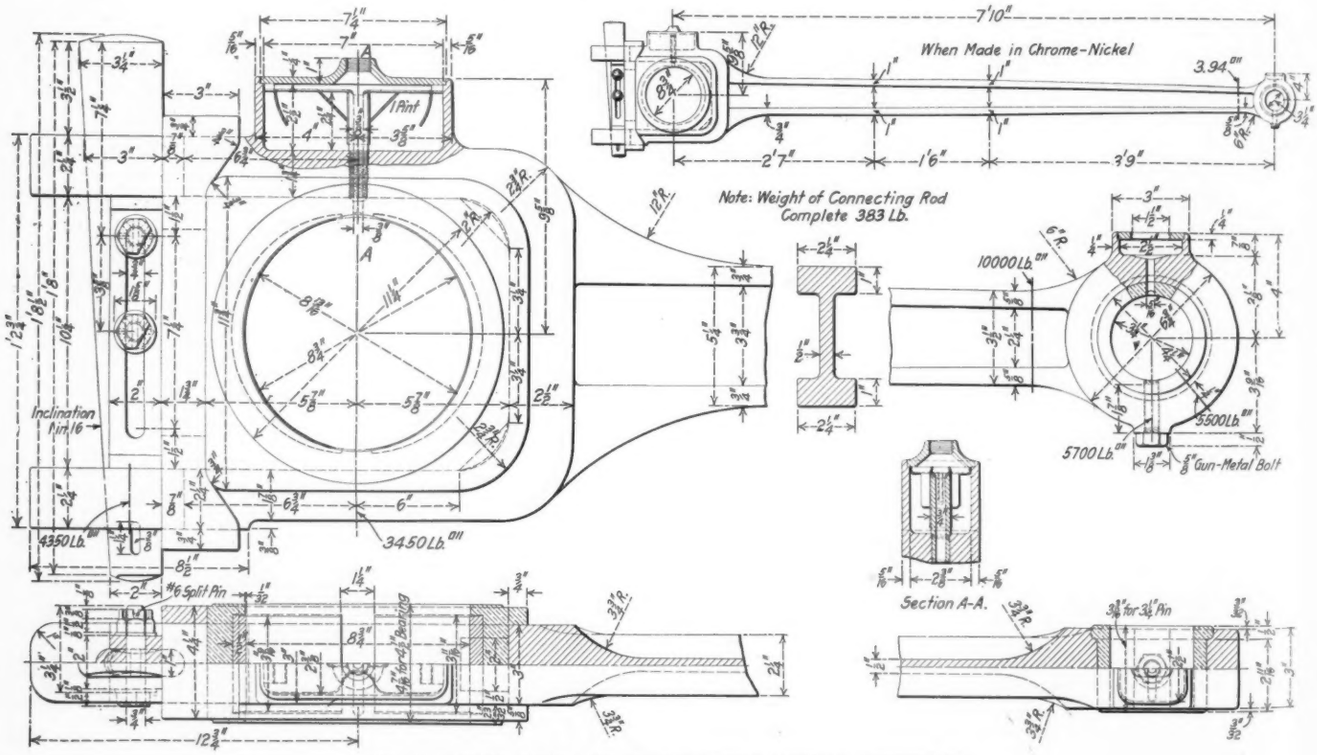


Fig. 32—Inside Main Rod of the Great Western Locomotive

*Baldwin Locomotive Works, Philadelphia.

has been made by the choice of the type of part used. Light types of pistons, crossheads and stubs have been chosen.

These examples of English design illustrate the point already made, that considerable reduction in weight can be made by simply choosing a light type of part. If, then, special alloy steel should be used and the designer has full confidence in the material, and works it up to its full capacity as regards strength, a still further saving is made in weight. This combination of choice of types and the use of alloy steel is clearly illustrated in the outside main rod of the Great Western's Pacific type locomotive, Fig. 31. This rod complete weighs only 244 lb. and carries 160 lb. of piston load per lb. weight of rod. For the length nearly 100 in. center to center, this is the lightest main rod that has come to the writer's attention.

For a detailed description of the reciprocating parts, the following locomotives have been chosen: Great Western, 4-6-2 type, four-cylinder, simple; London, Brighton & South Coast, 4-6-4 type, two-cylinder, simple; Midland, 2-8-0 type, two-cylinder, simple.

TABLE XII—DATA FOR RECIPROCATING PARTS OF BRITISH LOCOMOTIVES

Road and type	Cylinders and driving wheels	Boiler pressure, lb.	Piston load, lb. (area piston x full b. press.)	Weight, lb. Cross-head	Piston rod	Main rod	Total wt. of reciprocating parts, lb.	Piston load, lb. per lb. wt. rec. parts	per lb. wt. crosshead	per lb. wt. piston	per lb. wt. main rod
Great Western, 2-cyl., 4-6-0	18½ in. x 30 in.; 80 in.	220	59,100	258	330	473	824	71	230	180	125
Great Western, 4-cyl., 4-6-2	15 in. x 26 in.; 80 in.	220	39,000 inside 39,000 outside	193 124	195 188	383 244	541 434	74 90	202 314	200 207	102 160
Great Central, 2 cyl., 4-6-0	21½ in. x 26 in.; 81 in.	180	65,300	231	375	592	783	83	283	174	110
L. B. & S. C., 2-cyl., 4-6-4	22 in. x 28 in.; 81 in.	170	65,000	208	425	575	920	70	310	152	112
L. B. & S. C., 2-cyl., 4-4-2	21 in. x 26 in.; 79½ in.	160	55,000	191	347	476	776	71	288	158	115
Midland, 2-cyl., 2-8-0	21 in. x 28 in.; 55½ in.	190	65,800	137½	343	500	713	90	480	192	131
Average		...	.....	...	...	...	...	78½	301	180	122

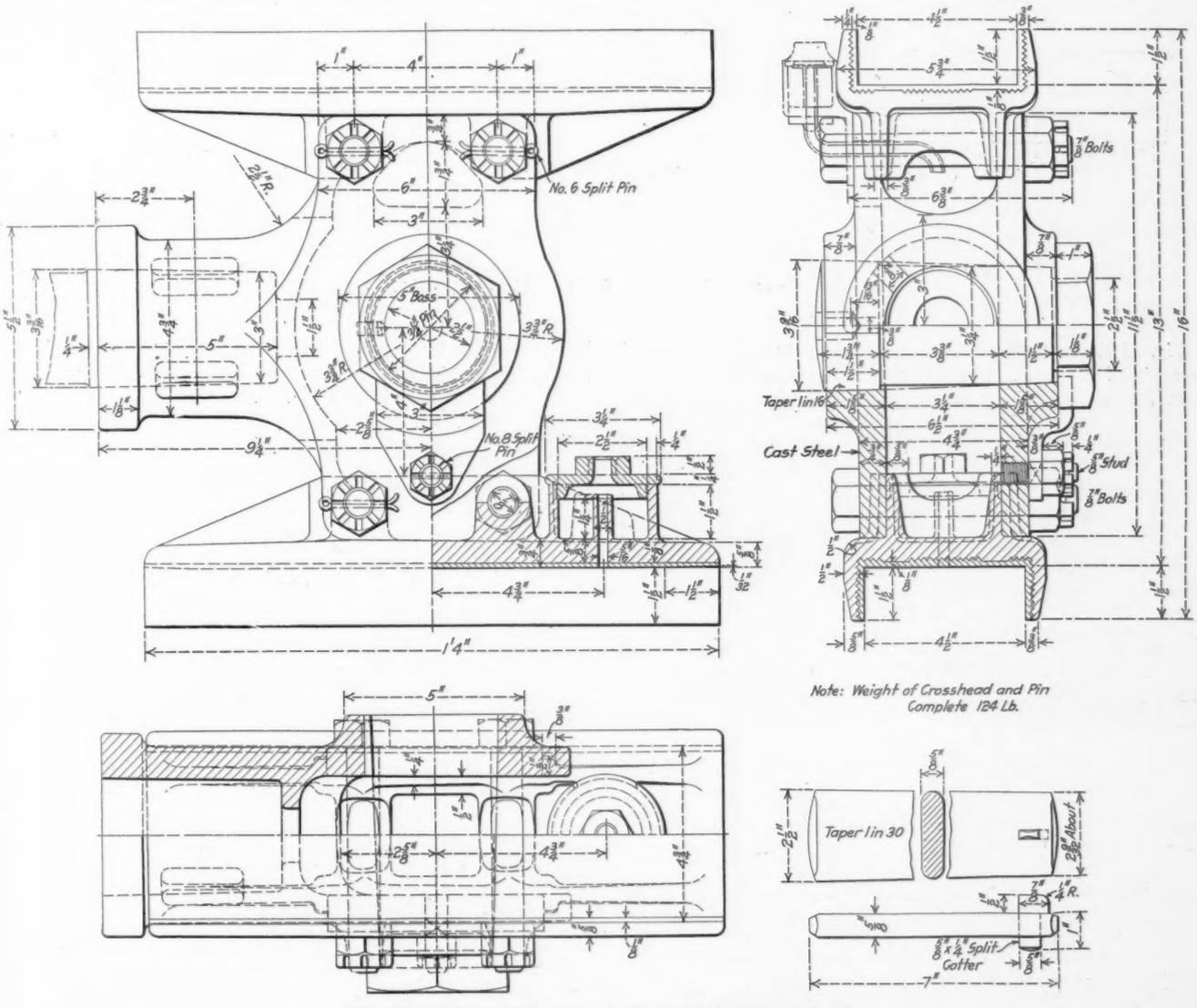


Fig. 34—Outside Crosshead of the Great Western Engine

The Great Western Pacific type is a four-cylinder balanced simple locomotive; the cylinders are 15 in. by 26 in., the

boiler pressure is 220 lb. per sq. in. (superheated steam), and the diameter of the drivers is 80 in. This locomotive is shown in the photograph. The outside and inside main rods are shown in Figs. 31 and 32. Both rods are nearly of the same length. The stresses are noted at the different sections for the outside rod. This rod is made of nickel-chrome steel, and as already stated, weighs only 244 lbs., but while the stresses are not low, it will be seen that they are well within the capacity of material of this character.

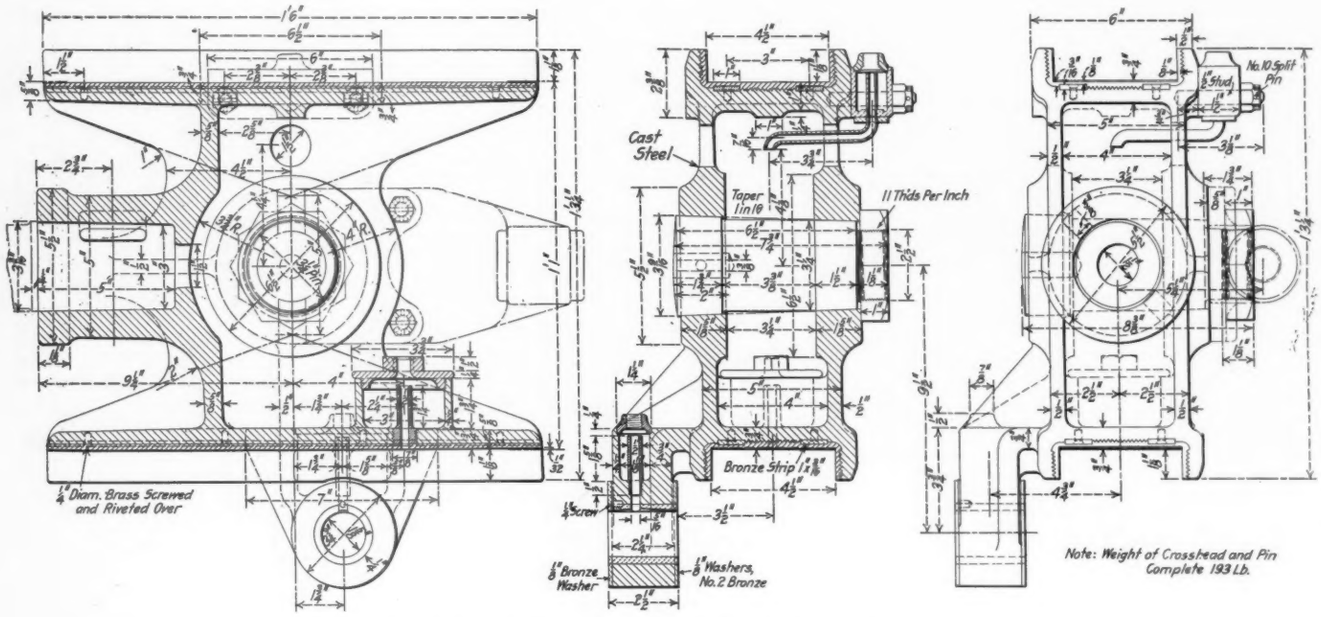

Cast Steel
Taper 1 in 10
11 Thds Per Inch
Bronze Strip
¼" Diam. Brass Screwed and Riveted Over
⅛" Bronze Washer
⅛" Washers, No. 2 Bronze
No. 10 Split Pin
Note: Weight of Crosshead and Pin Complete 193 Lb.

Fig. 35—Inside Crosshead of the Great Western Engine

Fig. 33 shows the piston. This is of the usual box type and is made of cast iron. Figs. 34 and 35 show the crossheads for both the outside and the inside cylinders of the Great Western engine. The stresses at the different sections in these crossheads are shown in table XIII.

TABLE XIII—STRESSES IN PISTON ROD AND CROSSHEAD OF GREAT WESTERN PACIFIC TYPE LOCOMOTIVE

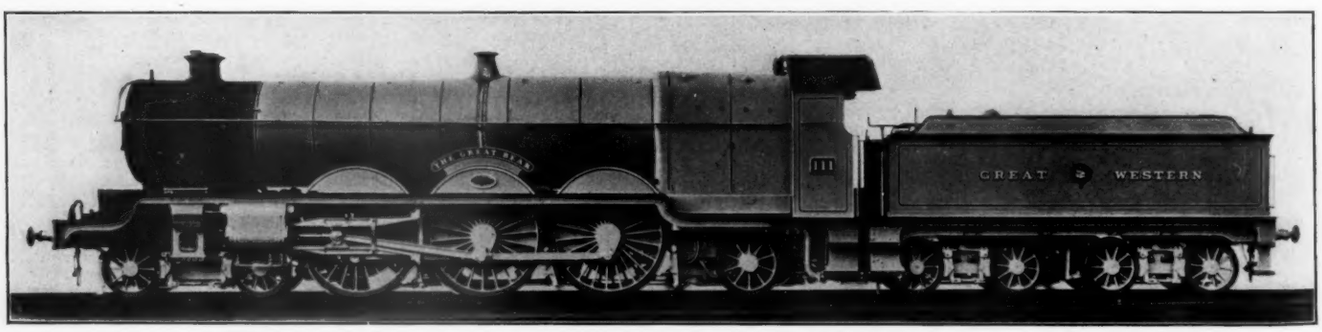
Section, and kind of stress	Amount of stress, lb. per sq. in.
Shear on key	13,850
Tension in rod through keyway	8,000
Tension in neck of crosshead through keyway	4,200
Crushing of key on the rod	21,000
Crushing of key on the crosshead	37,000
Bearing pressure, pin on crosshead	3,680
Compression in main shank of rod	6,090

CHARACTERISTICS OF PLATE SPRINGS*

BY GEORGE S. CHILES

PART II—(*Concluded*)—DESIGN

The action of a plate spring is similar to that of a simple beam supported at the ends and carrying a concentrated load at the center. The effect of a load upon such a beam is to cause it to bend; the tendency being to place the fibers at the upper surface in compression and those of the lower surface in tension. The intensity of the stresses increases directly as their distance from the neutral axis, the minimum stress being at the outer fibers; this is shown at the right in Fig. 20.



Four-Cylinder Simple Pacific Type Locomotive; Great Western of England

In addition to the bending stresses which act normal to a section, the beam is subjected to shearing stresses. At any section of the beam, the shear is equal to the sum of the vertical components of the external forces or loads on one side of that section. It is quite generally assumed that the shearing stresses are uniformly distributed over the cross section of the beam; in reality, the unit shearing stress at the neutral axis of a rectangular section is 50 per cent. greater than the mean value and is zero at the upper and lower edges.

Considering the case of a simple beam loaded at the center and

*The first instalment of Part II. appeared on page 340 of the July, 1915, issue.

supported at the ends, uniform strength for simple bending may be secured by varying the breadth B in proportion to its distance from the end support; in other words, by making the beam of constant depth and diamond shaped in plan, as in Fig. 21.

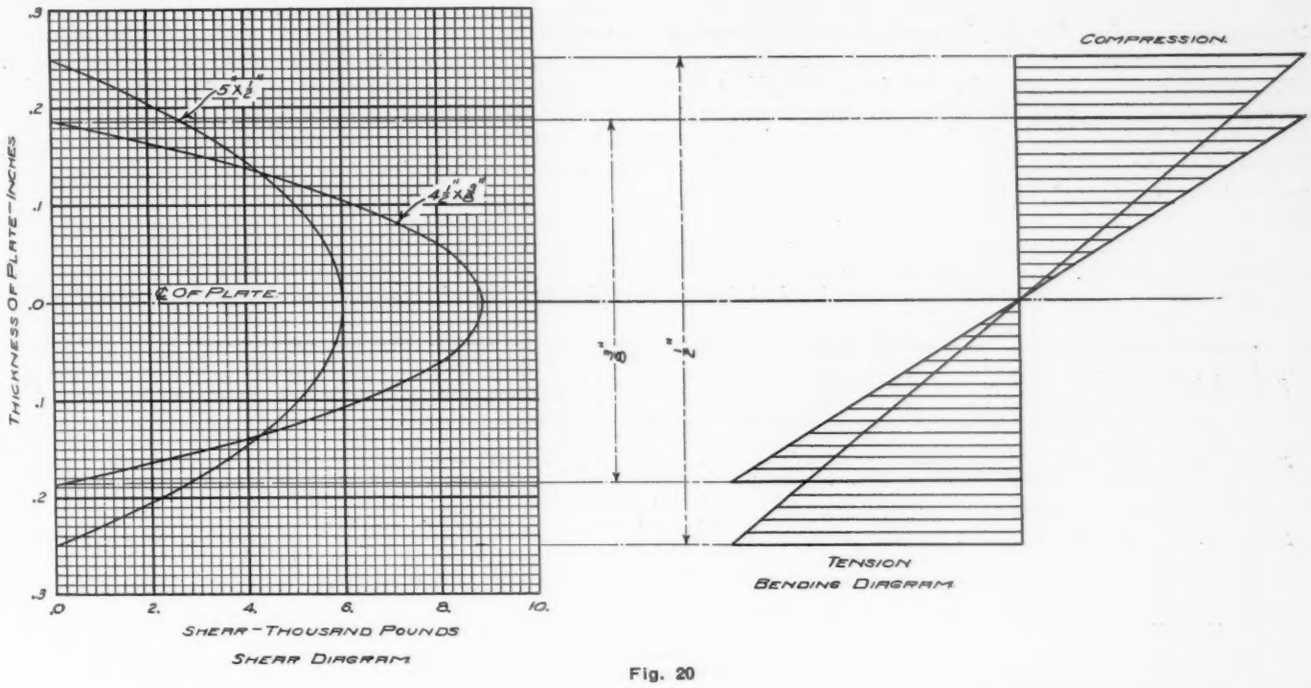


Fig. 20

Now, instead of using the diamond-shaped plate, if we cut equal widths of spring steel similar in shape and number to the strips 1, 2, 3, etc., at the top of the figure, and arrange them as in the two lower diagrams, we have a simple form of plate spring. It would be necessary in such a case to extend the main plate and it is the common practice in this country to roll the majority of the plates as is illustrated at the bottom of the figure, rather than taper them as shown in the diagram. Either method may serve the purpose if properly performed. Where the practice of tapering the plates is followed, the ends of the plates are usually tapered back so far that the end of one plate extends beyond the base of the taper of the next longer plate. In some instances where the plates are not rolled the corners are clipped off.

A discussion of the stress distribution in plate springs and how trimming the plates alters this distribution will be found in a paper entitled "The Determination of the Stresses in Springs and Other Bodies by Optical and Electrical Methods," read before Section G of the British Association at Dundee, September 11, 1912, by E. G. Croker, M.A., D.Sc., Professor of Mechanical Engineering in the City and Guilds of London Technical College, Finsbury, and published in *Engineering* (London), September 20, 1912. For the purposes of this article, it is sufficient to state that it is questionable as to whether any advantages are derived from the practice of tapering the ends of the various plates where the spring consists of a large number of plates.

Neglecting the effect of the friction between the plates, the strength and deflection of a spring as shown in the lower half of Fig. 21 would be similar to the diamond-shaped beam of thickness H, and considering the bending stresses only, the outer fibers are all stressed to the same degree. As a general rule, however, a plate spring only approximates a beam of uniform strength in that from a quarter to a fifth of the total number of plates extend the full length and in such cases are not rolled, with the possible exception of the last one. Two reasons are quite often advanced for thus deviating from a beam of uniform strength, one being to provide sufficient material at the ends of the spring to withstand the shearing stresses, the other that one surface of the outline of a spring should conform to a straight line and the other to a parabola. This is not borne out by the built-up beam of uniform strength shown in Fig. 21.

As an example of the stresses due to the shearing action let us consider two springs, one with the plates five inches by one-

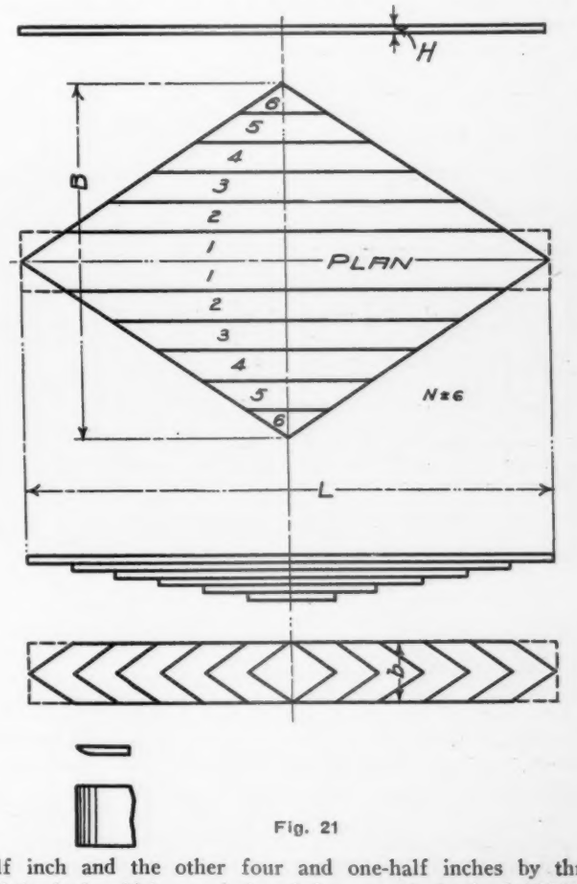


Fig. 21

half inch and the other four and one-half inches by three-eighths inch which are designed for a static load of 20,000 lb.

each, and assume that in each case the total shear is to act upon one plate only. Now, since for rectangular cross-sections, the shearing stresses vary as the ordinates of a parabola whose middle ordinate is equal to one and one-half times the total shear divided by the area, or $\frac{2a}{3s}$, the values for the maximum vertical shear are 6,000 lb. and 8,900 lb. respectively. We know that, if at any point in a strained body there is a shearing stress in one plane, there must of necessity be a shearing stress of equal intensity in another plane which is at right angles to it, each plane being perpendicular to the direction of the stresses in the other plane. The shear diagram in Fig. 20 indicates the location and extent of the vertical and horizontal shear at any section of the plates of either spring referred to. These purely shearing stresses are equivalent to resultant normal stresses at an angle of 45 deg. to the planes of the shearing stresses, one being a tensile stress and the other a compressive stress. Assuming that the tensile and comprehensive stresses, due to bending in one plate of each of the springs under discussion, is 80,000 lb. per sq. in., a value quite generally used in designing springs, and considering the maximum vertical shearing stress to be 8,900 lb., which is the value for the smaller plate, the maximum principal stress becomes:

$$S'_t = \tfrac{1}{2}S_t \pm \sqrt{S_t^2 + 4S_s^2}$$

in which S_t = unit stress in tension;
S_s = unit stress in shear.

In this case the maximum principal stress becomes 80,980 lb. per sq. in., or an increase over the tensile stress of 1.2 per cent. This increase is so small as to indicate that the shearing stress in any ordinary plate spring is not of sufficient importance to warrant the use of additional full length plates. Practically, however, the spring should contain more full length plates than are theoretically required, inasmuch as the breaking of a full length plate near the end would cause the adjoining plates to be subjected to a greater stress than would the failure of a plate near the center of the spring.

The section modulus at the center of a plate spring may be calculated by the formula:

$$SM = \frac{nbh}{6}$$

where n = number of plates of full section;
b = width of plate in inches;
h = thickness of plate in inches.

When one or more of the plates are rolled or are otherwise different in section, either b or h or both may vary considerably from their values for the plate of full section. This is of importance in dealing with old springs, since the decrease in thickness due to resetting and oxidation of a plate originally ⅜ in. thick may amount to as much as 1/32 in. or a decrease of 8.3 per cent. Since the strength of a plate varies directly as the square of its thickness the corresponding decrease in strength would be equal to 15.92 per cent., or practically 16 per cent. Should each of the ⅜ in. plates composing a spring lose 1/32 in. in thickness, the strength of the spring as a whole would thus be 16 per cent. less than before.

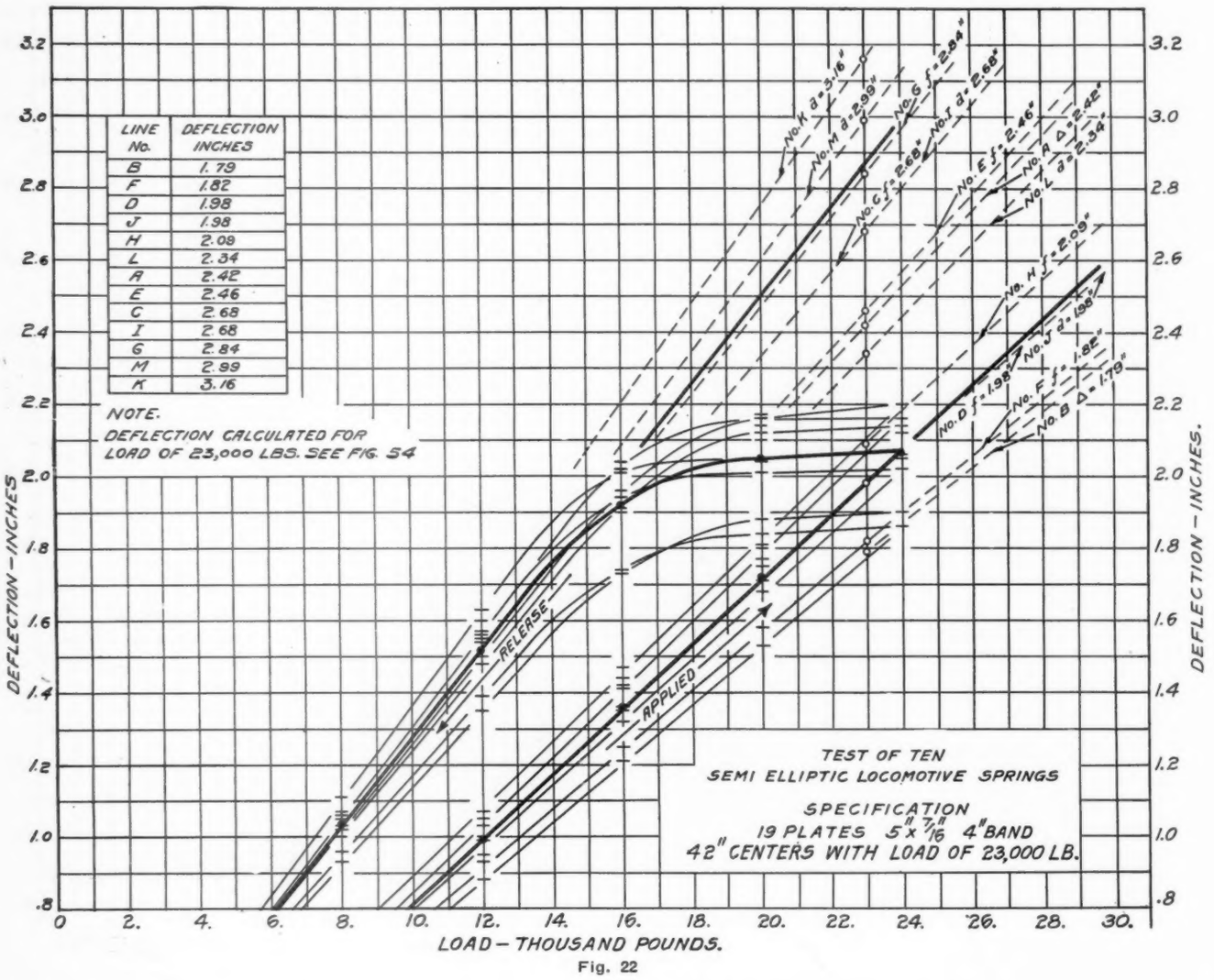


Fig. 22

Since the deflection varies inversely as the cube of the thickness of the plate, the corresponding increase in deflection for a reduction of 1/32 in. in the thickness of the plate would amount to no less than 22.89 per cent. Were all the plates to suffer a similar reduction in thickness, the deflection of the entire spring would therefore be increased approximately 23 per cent.

Any reduction in the width of the plate would, of course, also affect its strength and deflection, but to a very much less degree, since these properties vary directly as its width.

In this discussion we have adhered to the straight beam theory.

DEFLECTION FORMULAS FOR SEMI-ELLIPTIC SPRINGS

No.	Authority	Formula for Deflection	Load	Span	E Modulus of Direct Elasticity	Width of Plates	Thickness of Plates	Number of Plates	Width of Band
A	D. K. Clark	$\Delta = \frac{1.66 L^3}{b t^3 n}$	See Note	L	———	b	t	n	—
B	Ditto (Band Deducted)	$\Delta = \frac{1.66 (L-w)^3}{b t^3 n}$	See Note	L	———	b	t	n	w
C	Reuleaux	$f = \frac{6 P l^3}{E i b h^3 n}$	$2P$	$2l$	30,000,000	b	i	n	—
D	Ditto (Band Deducted)	$f = \frac{6 P (l-\frac{w}{2})^3}{E i b h^3 n}$	$2P$	$2l$	30,000,000	b	i	n	w
E	G. R. Henderson	$f = \frac{5.5 P l^3}{E n b h^3}$	$2P$	$2l$	30,000,000	b	h	n	—
F	Ditto (Band Deducted)	$f = \frac{5.5 P (l-\frac{w}{2})^3}{E n b h^3}$	$2P$	$2l$	30,000,000	b	h	n	w
G	Same as No. E. (Modulus Changed)	$f = \frac{5.5 P l^3}{E n b h^3}$	$2P$	$2l$	26,000,000	b	h	n	—
H	Ditto (Band Deducted)	$f = \frac{5.5 P (l-\frac{w}{2})^3}{E n b h^3}$	$2P$	$2l$	26,000,000	b	h	n	w
I	Mechanics Formula Beam of Uniform Strength	$d = \frac{3 P l^3}{8 E b h^3 n}$	P	l	30,000,000	b	h	n	—
J	Ditto (Band Deducted)	$d = \frac{3 P (l-\frac{w}{2})^3}{8 E b h^3 n}$	P	l	30,000,000	b	h	n	w
K	Same as No. I (Modulus Changed)	$d = \frac{3 P l^3}{8 E b h^3 n}$	P	l	25,400,000	b	h	n	—
L	Ditto (Band Deducted)	$d = \frac{3 P (l-\frac{w}{2})^3}{8 E b h^3 n}$	P	l	25,400,000	b	h	n	w
M	Proposed Formula	$d = \frac{P (L-w)^3}{53{,}000{,}000 b h^3 n}$	P	L	———	b	h	n	w

NOTE: E IN SIXTEENTHS OF AN INCH, Δ IN SIXTEENTHS OF AN INCH PER TON (2240 LBS.) OF LOAD

FOR A 13 PLATE 3"×⅜" SPRING WITH A LOAD OF 23000 LBS. $\Delta = \frac{1.66 L^3}{b t^3 n} = \frac{66 \times 42^3}{3 \times 13} \times \frac{23000}{2240} = 38{,}768$ (IN SIXTEENTHS OF AN INCH) $\times .0025 = 2.42$ INCHES. SEE FIG. 23

VALUES, UNLESS OTHERWISE NOTED, ARE IN POUNDS AND INCHES.

Fig. 23

While all the assumptions pertaining to it are not strictly true, they are sufficiently so for all practical purposes. Strictly speaking, springs as ordinarily built should be examined according to the formulas for the bending of curved bars, but the dimensions of the cross section of a plate being usually very small as compared with its length and radius of curvature, the ordinary beam formula will give the best approximations.

Neglecting the slight deflection due to vertical shear, the deflection at the center of a simple beam of uniform thickness and varying breadth, carrying a single load at the center and supported at each end is computed by the formula:

$$d = \tfrac{1}{4} \frac{PL^3}{EB\,h^3} \text{ where}$$

d = deflection of spring, in inches.
P = load on spring, in pounds.
L = length of spring between supports, in inches.
E = modulus of elasticity of material. For steel a modulus of 30,000,000 is ordinarily used, but this is sometimes altered in calculating springs to offset the effect of friction due to the sliding of the plates upon one another.
B = total width, in inches at the center, = $b \times N$ where b = breadth of a single plate in inches, and, N = number of plates in a built-up spring.

Practically, however, the actual deflection obtained by testing such a beam will be somewhat less than that obtained by the formula, since it is necessary to move the supports in a short distance from either end, which reduces the span.

In the caes of a plate spring additional variations are introduced. For instance, irregularities in fitting, such as variations in the openings between the plates, slight variations in the thickness of the different plates, and the condition of the bearing surfaces of the plates, especially at the ends, all affect the deflection of the spring. The almost universal custom of making from one-fifth to one-quarter of the total number of plates full length and the manner in which the ends of the remaining plates are rolled or tapered may also alter the deflection from that determined by formula. Finally, the effect of the band, by which the plates are held together, may be such as to decrease the effective span by an amount varying from zero to the full width of the band, which in railway practice may amount to from three to four inches. Another point which must be considered when dealing with the deflection of a built-up spring is the lack of perfect elasticity, due mainly to the friction between the plates. This is to some extent a measure of the ability of the spring to dissipate shocks.

The variations that may exist in different springs of the same design are clearly illustrated in Fig. 22. The data reproduced in this figure was gathered from tests upon ten different springs of the same design, but built by different manufacturers. Although all the readings for the ten tests are shown in the figure, in some instances those of two or more springs coincided, which accounts for the fact that in some cases but seven or eight distinct points appear. For a similar reason but six distinct curves are plotted, these being shown in the light lines. After plotting the readings for the 10 tests these were averaged and are indicated by the full circles and the resulting curve drawn in with a heavy line. Since the static load for which these springs were designed was 23,000 lb. and the test loads only amounted to 24,000 lb. it was necessary to extend these curves by a comparison with a similar spring which had been tested under a greater load. These curves bring out at once the extent to which the values of the deflection as obtained from different springs of the same design vary from each other.

In order to show the variations in the deflection values obtained by using various spring formulas, those shown in Fig. 23 were applied to the spring referred to in Fig. 22. The results are shown by the broken lines in the upper part of the diagram and are tabulated for a load of 23,000 lb. That the deflection value will vary considerably according to the formula selected is clearly apparent and the designer is at once confronted with the perplexing question as to the proper formula to use.

Since there is very little information on record relative to the service deflection of railway plate springs, the author considers it inadvisable to attempt to base spring design on service deflection. In the preceding discussion attention has also been called to the fact that the value of the deflection as obtained from the applied load curve in testing is unreliable, since it depends upon a number of varying conditions. Generally speaking, the value obtained from the release load curve is much less affected by these conditions, and it will also be found to agree fairly well with the deflection of the spring in service. The height under service of passenger car bolster springs will be found to fall somewhere between the mean resultant of the applied and release load curves and the release load curve itself. In locomotive practice the service height of the spring will approximate very closely the release load height.

The release load curve is therefore considered the best basis upon which to develop a consistent formula for deflection. Combining the constant and the value of the modulus of elasticity in the formula for the deflection of a beam of uniform strength, it becomes:

$$d = \frac{P\ (1\text{-}w)^3}{80{,}000{,}000\ b\ h^3\ n}$$

in which w = width of the band.

Assuming that the values of P, l, w, b, h, and n, remain constant, it is clear that by substituting the average results of a large number of tests for the value of the deflection d, it is possible to determine the value of a constant a which, when substituted in the formula for the theoretical constant 80,000,000, will give results agreeing fairly closely with those of the actual tests. In this way the value of a has been found to be 53,000,000, which, on being substituted in the formula, increases the deflection 33.75 per cent. The formula in its final form is:

$$d = \frac{53{,}000{,}000\ b\ h^3\ n}{P\ (1\text{-}w)^3}$$

and is suitable for both semi-elliptic and full elliptic springs, the value obtained from the formula being doubled in the latter case. It will give satisfactory results not only for fully graduated springs having a minimum number of full length plates, but for those having one-quarter of the plates full length.

EXAMPLES OF RECENT LOCOMOTIVES OF THE ATLANTIC, TEN-WHEEL AMERICAN, MOGUL, AND SWITCHING TYPES

ARRANGED IN ORDER OF TOTAL WEIGHT

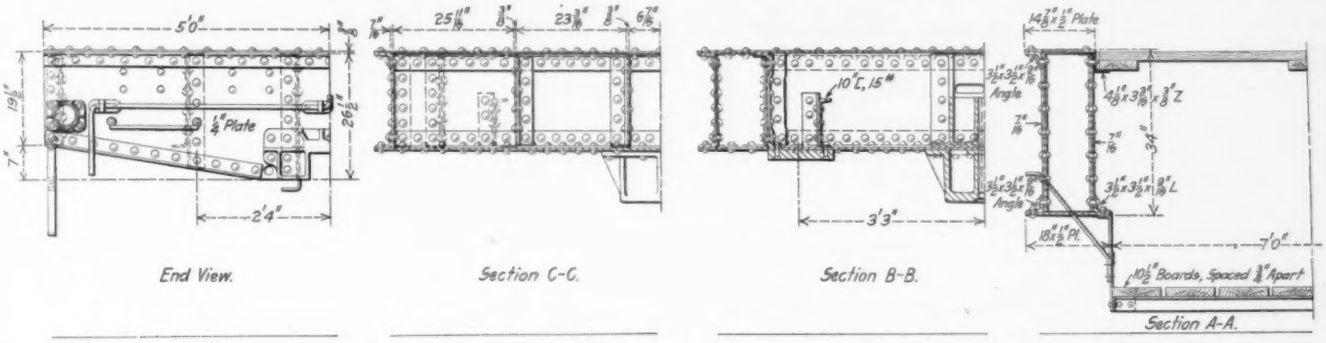
Type	4-4-2	4-4-2	4-4-2	4-4-2	4-6-0	4-6-0	4-6-0	4-6-0	4-6-0	4-4-0	2-6-0	2-6-0	0-10-0	0-8-0	0-8-0	0-8-0	0-6-0	0-6-0
Name of road	P.R.R.	C.R.I.&P.	Sou. Pac.	Mo. Pac.	Sou. Pac.	D.& H.	G.S.&F.	Can. Nor.	S.A.U.&G.	P.&R.	Vandalia	D.L.&W.	N.Y.C.	N.Y.C.	L.&N.	C.N.E.	I.C.	Southern
Road number or class	E6s	W-28	3048	5531	2368	D3b	179	280	30	419	158	545	M4	4299	2100	109	218	1728
Builder	R.R. Co.	Amer.	Baldwin	Amer.	Amer.	Amer.	Baldwin	Amer.	Amer.	Baldwin	Amer.	Amer.	Amer.	Amer.	.....	Amer.	Amer.	Lima
When built	1913	1910	1911	1912	1913	1912	1914	1911	1914	1914	1907	1909	1907	1914	1915	1913	1913	.....
Tractive effort, lb.	29,427	29,600	23,500	24,990	36,500	31,500	31,500	28,900	26,200	27,850	33,400	29,480	55,360	49,500	46,900	45,200	32,450	32,000
Weight, total, lb.	240,000	202,000	196,000	191,000	222,000	199,000	192,250	173,000	147,500	173,490	187,000	171,500	274,000	239,500	219,000	202,500	166,000	145,500
Weight on drivers, lb.	133,100	116,000	105,000	115,000	173,500	147,500	147,200	133,000	113,500	120,530	159,000	150,500	274,000	239,500	219,000	202,500	166,000	145,500
Weight on leading truck, lb.	55,000	49,000	45,000	42,000	48,500	51,500	45,050	40,000	34,000	52,960	27,700	21,000	.....	.....	.....	.....	.....	.....
Weight on trailing truck, lb.	51,900	37,000	46,000	34,000	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Weight on tender, loaded, lb.	158,000	149,900	159,000	146,500	140,400	145,500	147,750	123,650	123,000	146,510	146,000	129,300	151,700	148,300	139,000	119,500	100,400	93,300
Wheel base, driving, ft. & in.	7—5	7—0	7—0	7—6	13—10	15—0	15—0	14—6	12—0	9—0	14—9	15—0	19—0	16—0	15—0	15—0	11—8	11—0
Wheel Base, total engine, ft. & in.	29—7½	30—10	27—7	29—8	25—10	26—9	25—11½	24—10	23—1	24—9	23—10	23—10	19—0	16—0	15—0	15—0	11—8	11—0
Wheel base, engine and tender, ft. & in.	63—10½	62—8	58—2	59—7⅛	58—1⅛	58—0½	61—4	54—3	56—1	56—11⅜	56—10¼	52—7½	54—7½	53—8½	54—4	47—8¼	42—11⅜	43—4¾
Diameter of drivers, in.	80	73	81	78	69	63	68	63	56	68½	63	63	52	58	51	51	51	51
Cylinders, number	2	4	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Cylinders, diameter, in.	23½	17½	20	21	23	23	21	22	20	21	21	20½	24	25	23½	22	21	20
Cylinders, stroke, in.	26	26	28	28	28	26	28	26	24	24	28	26	28	30	30	28	26	26
Valve gear, type	Wals.	Wals.	Steph.	Steph.	Wals.	Wals.	Southern	Wals.	Wals.	Wals.	Wals.	Wals.	Wals.	Wals.	Wals.	Wals.	Wals.	Steph.
Steam pressure, lb.	205	160	200	200	200	170	200	170	180	210	200	200	210	180	170¶	200	180	185
Boiler, type	Belpaire	E.W.T.	Straight	Straight	E.W.T.	E.W.T.	W.T.	Conical	Straight	Wootten	Straight	Straight	Conical	E.W.T.	Straight	.....	.....	E.W.T.
Boiler, smallest outside diameter, in.	78½	68⅛	70	68	72	66¼	67¼	66	60	62	77	66	80⅛	72⅛	80	74⅜	63	63
Tubes, number and diameter in inches.	242—2	206—2	297—2	362—2	204—2	206—2	199—2	185—2	145—2	208—1¾	390—2	310—2	446—2	214—2	173—2¼	402—2	151—2	302—2
Flues, number and diameter in inches.	36—5⅜	24—5¼	.....	.....	28—5⅜	28—5⅜	26—5⅜	26—5⅜	21—5⅜	22—5¼	.....	.....	.....	30—5½	32—5½	.....	19—5½	.....
Length of tubes and flues, ft. & in.	15—0	18—0	16—0	16—⅛	15—0	14—6	15—0	13—2¼	13—5	10—5	13—7	13—6	19—0	16—6	14—8	15—0	13—4	15—1½
Heating surface, tubes and flues, sq. ft.	2660.5	2521.0	2475.0	3012.0	2181	2120.0	2100	1746.0	1405.2	1297	2754.6	2176	4416.0	2547	2157	3139	1409	2376
Heating surface, firebox, sq. ft.	195.7	194.5	179.8	182.5	219	150.7	168	183.0	155	220†	180.4	161	186.2	204†	222†	171	150.5	110
Heating surface, total, sq. ft.	2856.2	2715.5	1654.8	3194.5	2400	2270.7	2268	1929.0	1560.2	1517	2935.0	2337	4602.2	2751	2379	3332	1559.5	2486
Heating surface, superheater, sq. ft.	721	479	.....	.....	475	461.0	462	403.2	310	257	.....	.....	.....	579	525	....	266.6	.....
Heating surface, equivalent,* sq. ft.	3937.7	3450.5	.....	.....	3122.5	2962.2	2961	2332.2	1870.2	1902	.....	.....	.....	3330	3166	.....	1826.0	.....
Grade area, sq. ft.	55.13	42.8	49.5	44.5	32.1	50.2	49	31.6	31.5	86	52	53.4	55	53.3	53	47.5	38.8	29
Firebox, length, in.	110½	102⅜	108	96.0	124	96	107⅛	113⅛	107⅝	114¼	108	102	108⅛	102	106⅜	96	109⅝	65⅛
Firebox, width, in.	72	60¾	66	67.0	37½	75¼	66	40¼	42⅛	108¼	69	75	73¼	75¼	72¼	71¼	78	65¼
Kind of fuel	Bit. coal	Bit. coal	Oil	Bit. coal	Oil	Bit. coal	Bit. coal	Bit. coal	Bit. coal	Ant. coal	Bit. coal	Bit. coal	Bit. coal	Bit. coal	Bit. coal	Bit. coal	Bit. coal	Bit. coal
Tender, fuel capacity, tons or gallons	13	13	2835	14	2940	14	12	10	11	10½	13	10	12	14	12	10	6½	7
Tender, water capacity, gal.	7000	7500	9000	7000	7000	6800	7500	6000	6000	7000	7500	6500	8000	7500	7000	6000	5500	4500
Weight on drivers ÷ tractive effort	4.52	3.29	4.47	4.60	4.75	4.68	4.67	4.60	4.33	4.32	4.76	5.1	4.45	4.84	4.67	4.49	5.11	4.54
Total weight ÷ tractive effort.	8.15	6.83	8.34	7.65	6.08	6.31	6.10	5.98	5.63	6.23	5.60	5.81	4.45	4.84	4.67	4.49	5.11	4.54
Tractive effort × diam. drivers ÷ equivalent heating surface*	599.00	597.90	717.00	609.00	809.00	670.00	723.40	780.90	788.2	1003	717.00	795.00	625.00	862.20	755.50	692.00	906.30	656.50
Equivalent heating surface* ÷ grate area.	71.30	80.60	53.80	71.80	97.00	59.00	60.40	73.80	59.40	22.10	56.50	43.60	84.00	62.50	59.70	70.10	47.00	85.90
Firebox heating surface ÷ equivalent heating surface*, per cent	4.93	5.65	6.75	5.72	7.04	5.09	5.67	7.85	8.29	11.56	6.13	6.80	4.03	6.13	7.01	5.12	8.27	4.42
Weight on drivers ÷ equiv. heat. surface*	33.80	33.60	63.50	36.00	55.80	49.70	49.70	57.00	60.60	63.40	54.30	64.50	59.50	72.00	69.20	60.80	91.00	58.40
Total weight ÷ equiv. heat. surface	61.00	58.50	73.80	59.70	71.50	67.20	65.00	74.20	78.90	91.30	63.80	73.50	59.50	72.00	69.20	60.80	91.00	58.40
Volume both cylinders	13.10	14.43	10.15	11.20	13.30	12.48	11.20	11.40	8.73	9.64	11.20	9.95	14.66	17.07	15.08	12.20	10.37	9.50
Equiv. heat. surface* ÷ vol. cylinders.	300.00	239.00	262.00	285.00	233.00	238.00	264.00	204.00	214.00	197.00	262.00	234.00	314.00	195.00	210.00	272.00	176.00	262.00
Grate area ÷ vol. cylinders	4.21	2.97	4.92	3.98	2.41	4.02	4.37	2.77	3.61	8.94	4.65	5.38	3.75	3.12	3.53	3.89	3.75	3.04
Reference to photographs, drawings or description	R.A.G.M.E.‡ 1914-p69	Loc. Dic.§ 1912-p180	Loc. Dic.§ 1912-p179	Loc. Dic.§ 1912-p179	.....	Loc. Dic.§ 1912-p225	.....	Loc. Dic.§ 1912-p180	.....	R.A.G. Apr. 1914-p874	.....	Loc. Dic.§ 1912-p168	Loc. Dic.§ 1912-p164	.....	.....	.....	.....	Loc. Dic.§ 1912-p204

*Equivalent heating surface = total evaporative heating surface + 1.5 times the superheating surface. §Locomotive Dictionary. ‡*Railway Age Gazette, Mechanical Edition.* †Includes arch tube heating surface. ¶Boiler designed for 200 lb.

CAR DEPARTMENT

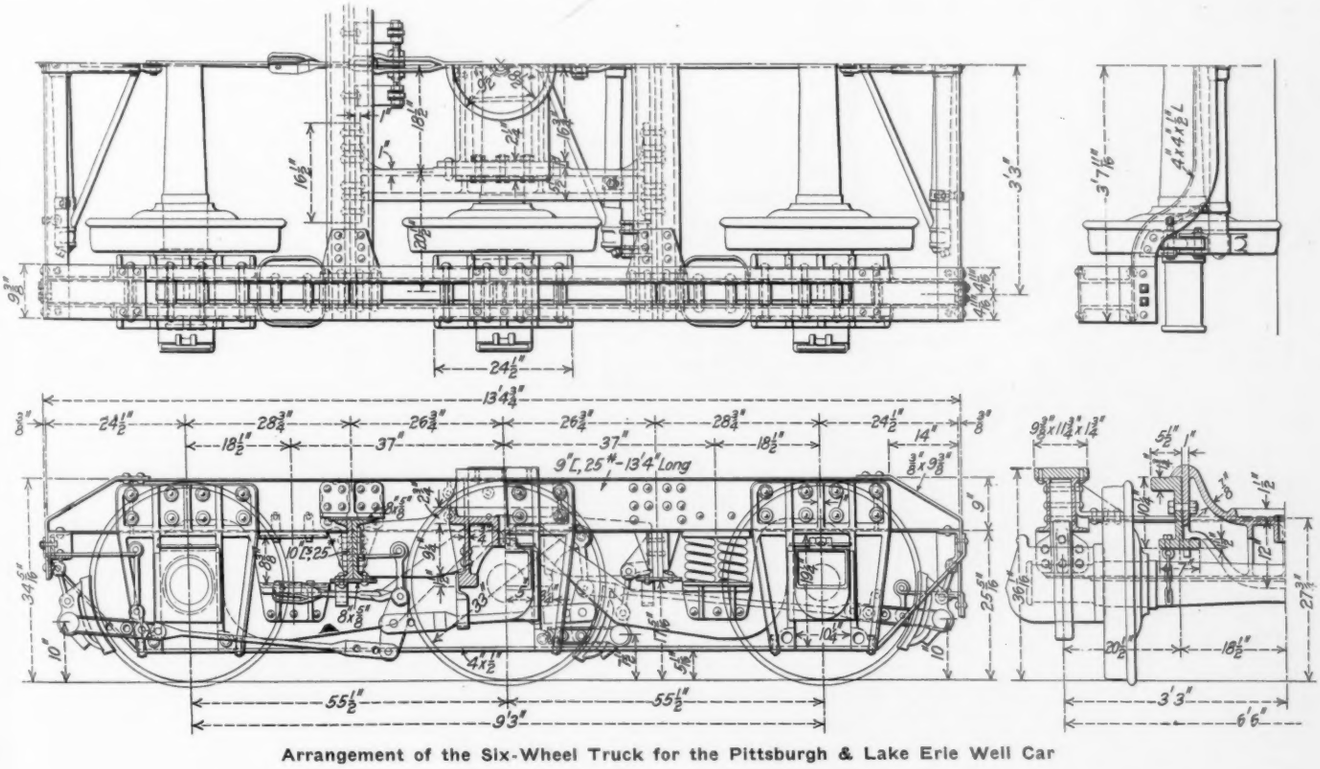
WELL CAR OF 200,000 LB. CAPACITY

The Pittsburgh & Lake Erie has in service two well cars of 200,000 lb. capacity and weighing 75,500 lb., designed for the distribution of the weight of the lading over a distance of 20 ft. at the center. The well opening is 27 ft. long by 7 ft. wide and is provided with a removable decking made in six sections. The well or pit also has a guard or safety floor below.



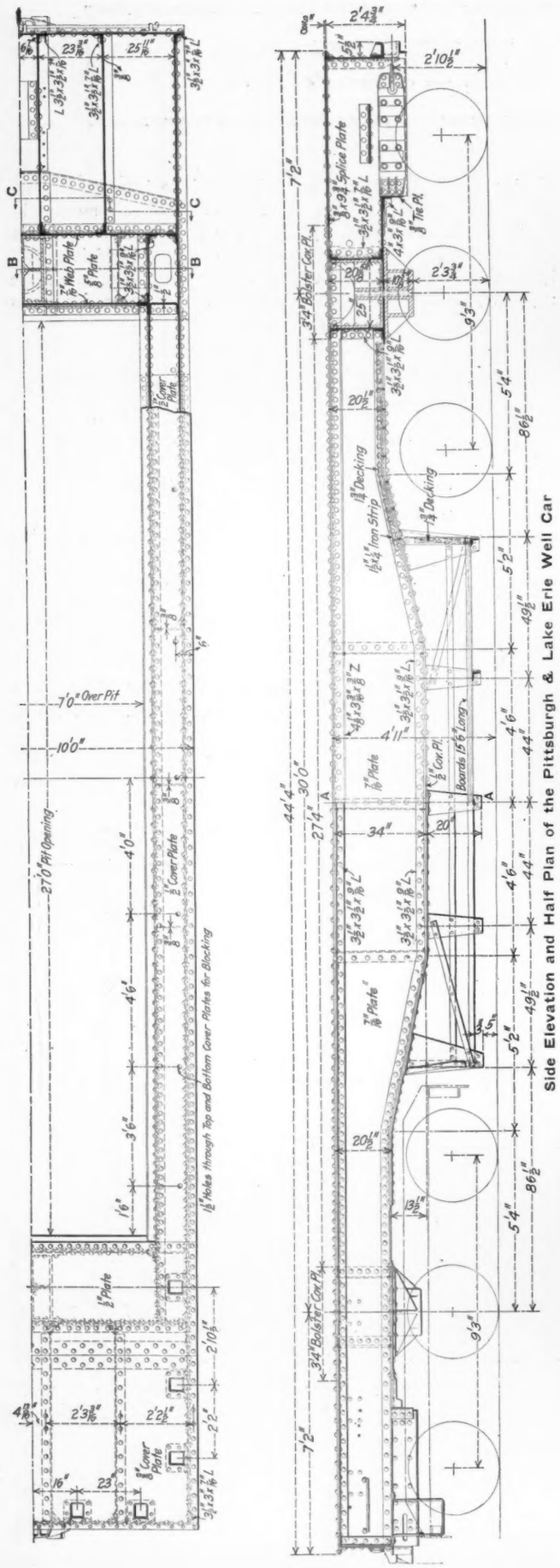
Cross Sections of the Well Car; the Letters Refer to the Elevation Drawing

Structural steel is used almost entirely in the construction of these cars. The end sill is built up of ¼-in. plate reinforced with angles and is 26½ in. deep at the striking casting. The center of the body bolster is 7 ft. 2 in. from the end of the car and the draft castings are connected to ⅜-in. plate sills placed 6 7/16 in. on either side of the centerline of the car and extending between the end sill plate and the body bolster. A similar sill is placed at a point intermediate between this sill and the outside plate of the side sill and both are connected by angles to the 7/16-in. web plate of the body bolster. A ⅜-in. top cover plate extends the full width of the car and is spliced by another ⅜-in. plate to the ½-in. bolster top cover plate, while a ⅝-in. plate is used at the bottom of the bolster and extends out at the center to the back end of the draft castings. The web plates of the body bolsters are placed 25 in. apart and a 10-in., 15-lb. channel connects them at the side bearings. The outer web plate extends completely across the car, while the inner one stops at the inner web plate of the side sill, to which it is connected by a 3½ in. by 3½ in. by 9/16 in. angle, a ½ in. pressed filler being placed at this point between the two web plates of the side sill.

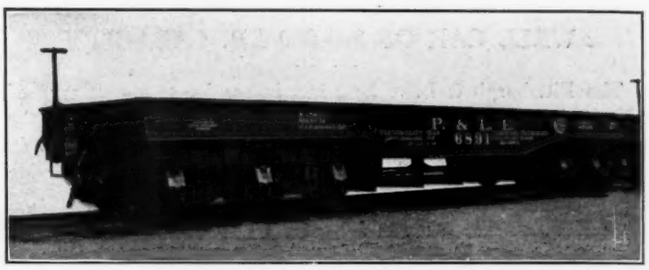


Arrangement of the Six-Wheel Truck for the Pittsburgh & Lake Erie Well Car

The side sills are of the fishbelly type, 20½ in. deep at the



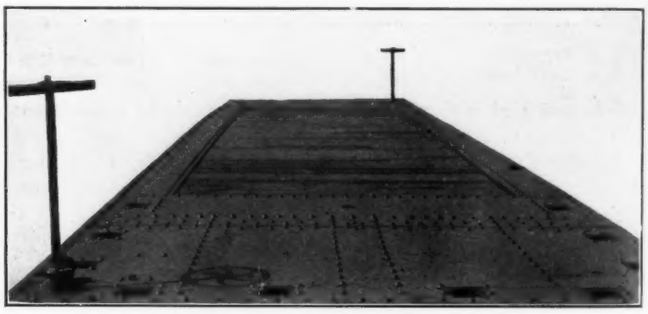
bolsters and 34 in. deep at the center. They are built up of two 7/16-in. web plates, the outer one of which extends the full length of the car, while the inner extends between the outer web plates of the body bolsters. The side sill web plates are connected to top and bottom cover plates by 3½ in. by 3½ in. by 9/16 in. angles, while a 4⅛ in. by 3 3/16 in. by ⅜ in. Z-bar is riveted to



Pittsburgh & Lake Erie Well Car

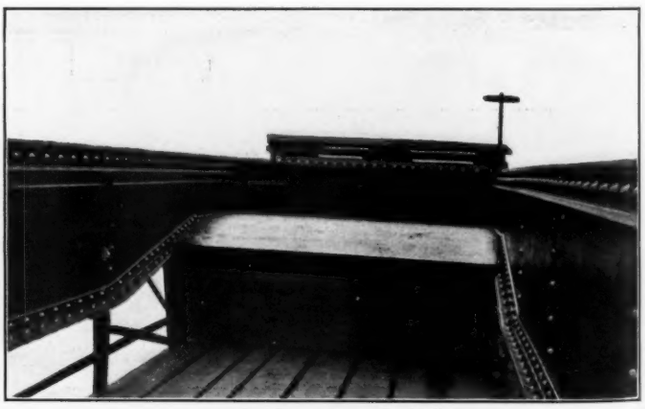
them on the upper side for the length of the well to support the decking. The top cover plate is 14⅞ in. by ½ in. by 27 ft. 4 in. long, while the bottom one is 18 in. by ½ in. and extends between points somewhat short of the body bolsters.

The cars are 44 ft. long over the deck and the trucks are spaced 30 ft. between centers. The trucks are of the six-wheel



Top View of the Well Car

type, with a wheelbase of 9 ft. 3 in., the bolsters and pedestals being of cast steel, while the frames are of structural steel, the side members being 9-in., 25-lb. channels. The trucks are equalized and forged steel wheels are used, mounted on axles with 6 in. by 11 in. M. C. B. journals. Each end of the car is equipped



View Showing the Interior of the Well

with its own braking apparatus, both hand and air operated. The body center plates, body bolster fillers, and the striking plates are of cast steel. The safety floor is of light construction and is so arranged that it can be removed in case the lading is of such a nature that extreme depth is required.

TESTING CAR ROOFS

At a recent meeting of the Car Foremen's Association of Chicago, F. C. Maegly, assistant general freight agent of the Atchison, Topeka & Santa Fe, mentioned a spraying device

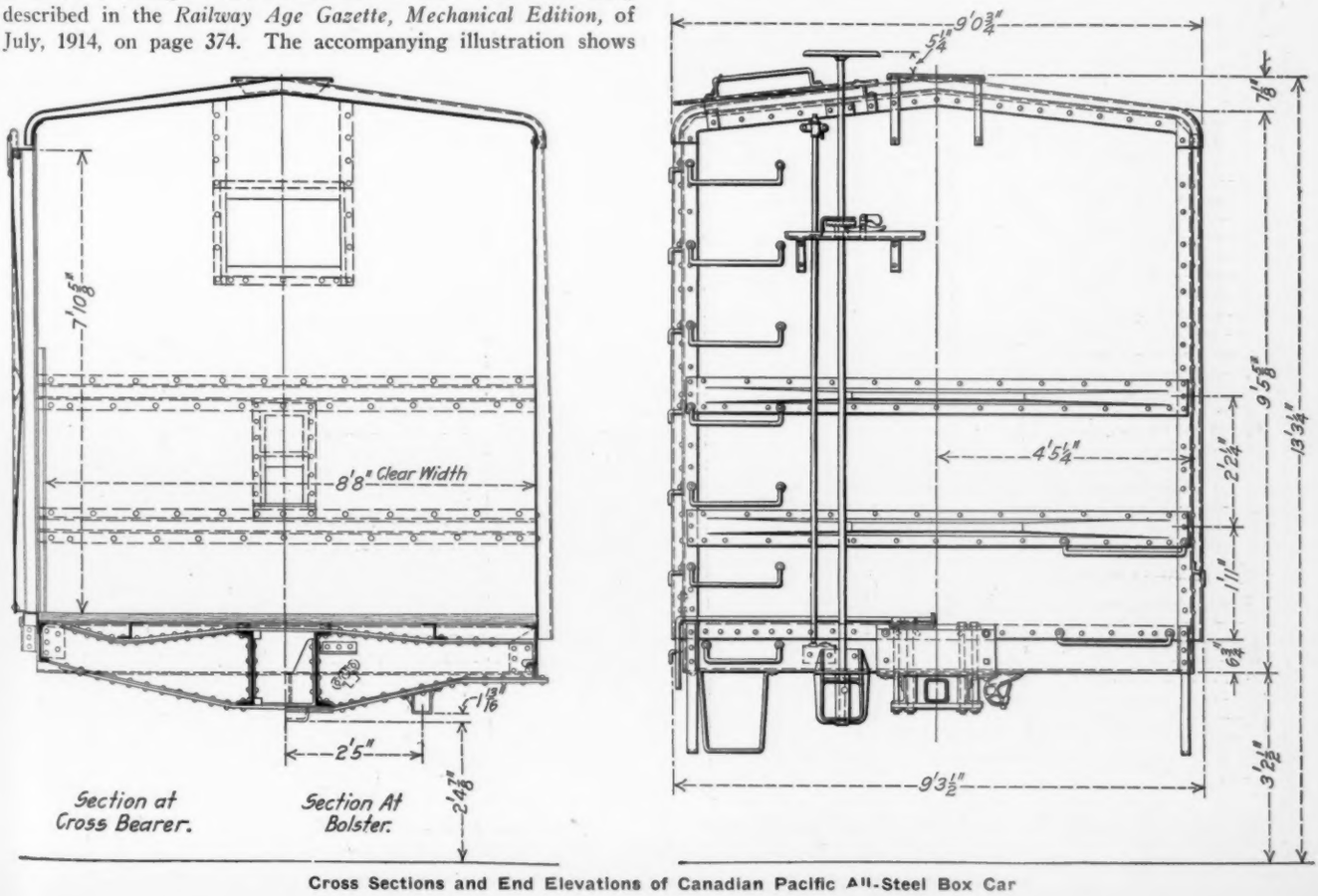
Testing Car Roofs for Leakage at the Topeka Shops of the Atchison, Topeka and Santa Fe

used at the Topeka shops for the purpose of testing the roofs of cars for leakage. The construction of this device was briefly described in the *Railway Age Gazette, Mechanical Edition,* of July, 1914, on page 374. The accompanying illustration shows the device in operation, the house from which the device is controlled is shown in the foreground. The method followed at Topeka is to haul the cars to be tested under the spray twice, with all the doors closed. After this the inspectors enter the cars and distinctly chalk all the leaks so that the foreman and the repair men in the shops will know what repairs are necessary. After the cars have been repaired and painted they are again placed under the spray, and any leaks that may have been overlooked by the repair men are repaired before the car is allowed to go. The volume of water is so great that it is possible to discover leaks in the side sheathing or the ends of the car. This device was originated by Charles M. Swanson, superintendent of car shops, Atchison, Topeka & Santa Fe at Topeka, Kan.

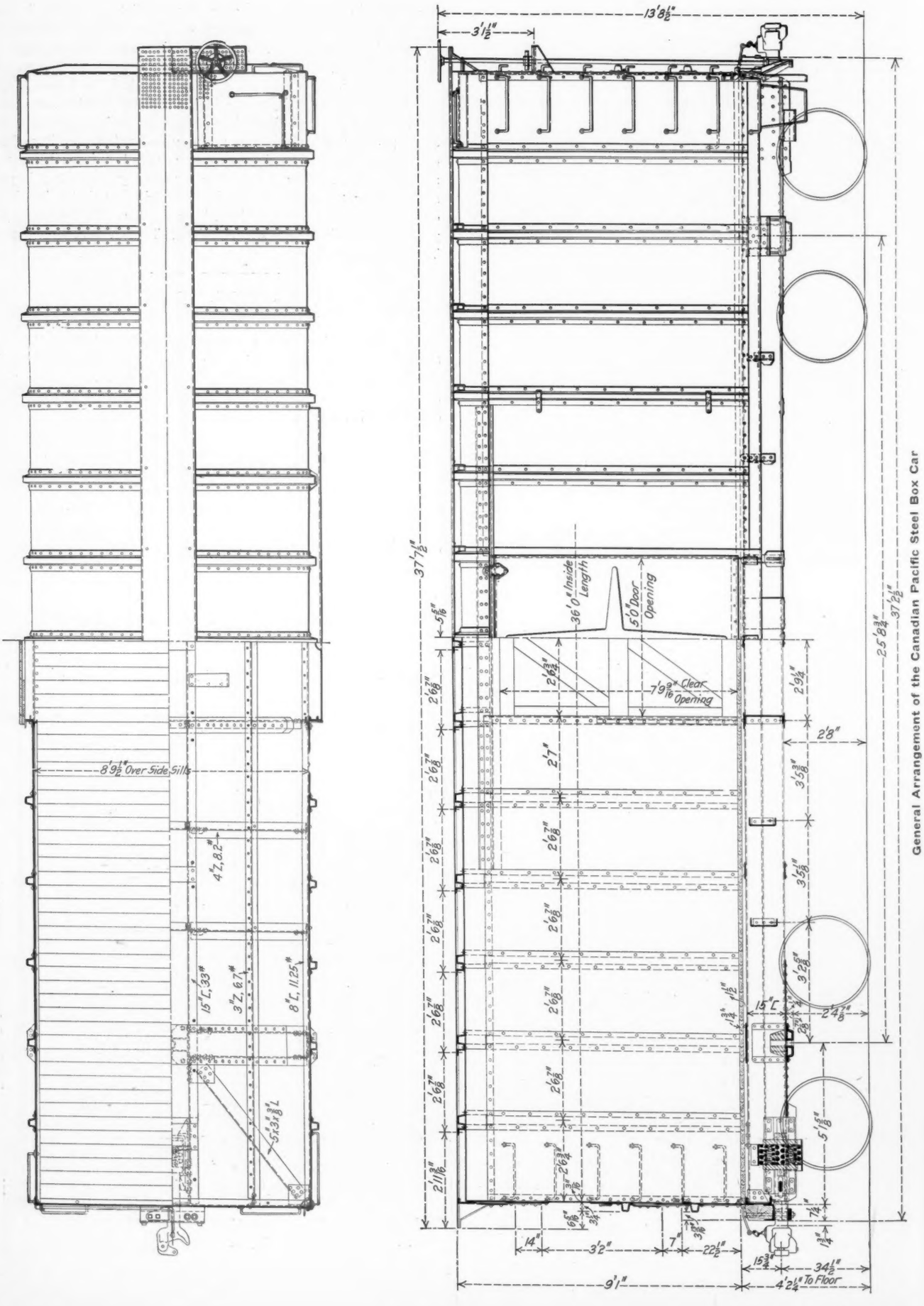
ALL-STEEL BOX CAR

An all-steel box car recently designed and built by the Canadian Car & Foundry Company, Montreal, Que., and now in service on the Canadian Pacific, is shown in the accompanying engravings. The car weighs 37,000 lb. and has an inside length of 36 ft. with a clear inside width of 8 ft. 8 in.

The construction of the car body is such that the interior surface is smooth, there being no braces employed in the side and end frames. The side posts are formed by pressing one vertical edge of each side sheet into a U section and are spaced 2 ft. 6⅞ in. between centers. The portion of the side sheets forming these posts is also offset to lap over the flat edge of the adjoining plate. A similar construction is employed in forming the roof members, the pressed U section in the roof sheets being made to correspond and to lap over the side sheets, thus practically forming a continuous post from side sill to side sill. As shown in the illustrations, these combined posts and carlines are on the exterior of the car, leaving a smooth interior which



Cross Sections and End Elevations of Canadian Pacific All-Steel Box Car


13'8½"
3'1½"
37'7½"
36'0" Inside Length
5'0" Door Opening
7'9 3/16" Clear Opening
2'8"
8'9½" Over Side Sills
15"C, 33#
3"Z, 6.7#
8"C, 11.25#
5x13 3/8"L
15"C
9'1"
4'2¼" To Floor
General Arrangement of the Canadian Pacific Steel Box Car

helps increase the loading space and makes the car easy to clean. The side plates are 3/16 in. thick and the roof plates are ⅛ in. thick, while the end plates are 3/16 in. thick and are reinforced by horizontal stiffeners of U-shaped section. Two sliding doors are provided in one end of the car to facilitate the loading of lumber and other long material. The running board is supported on angles riveted to the roof sheet.

The car is 37 ft. 2½ in. long over the buffer blocks on the end sills and the distance between center plates is 25 ft. 8¾ in. The center sills are 15-in., 33-lb. channels, which are connected by channel-section distance pieces, spaced at 3 ft. 5⅛ in. intervals, and by plates at various points throughout the length of the car, there being no cover plates employed except on the under side for a short distance at the body bolsters. The body bolsters are built up of ¼ in. pressed steel webs or fillers with ½ in. top cover plates and ½ in. bottom cover plates. There are two cross-bearers placed 2 ft. 9¼ in. on either side of the center line of the car and built up of ¼ in. pressed fillers ½ in. top cover plates and ½ in. bottom cover plates. The side sills are 8-in. 11.25-lb. channels and there are 5 in. by 3 in. by ⅜ in. diagonal bracing angles at the ends of the car, between the junction of the side and end sills at the corner of the car and the junction of the body bolster and the center sills. The center and the side sills are connected by 4-in., 8.2-lb. Z-bars and these support a 3-in., 6.7-lb. Z-bar placed about midway between the side and the center sills on both sides of the car, which acts as a floor stringer. The end sills are built up of steel plates and angles.

The drawings show provision for a steel door, but a wooden door was used on the car as shown in the photograph. The capacity of the car is 80,000 lb.

End View of the Canadian Pacific Car

Steel Box Car Built for the Canadian Pacific by the Canadian Car & Foundry Company

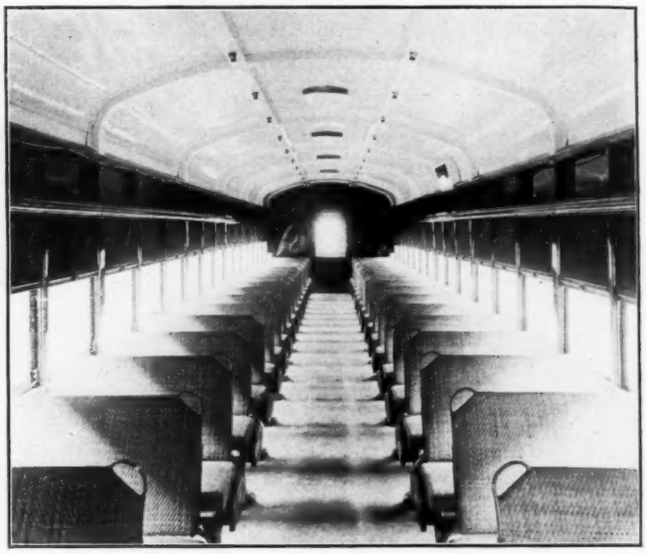
LONG ISLAND STEEL SUBURBAN CARS

Unlined Trailers Built for Summer Service Only; Exceptionally Low Weight per Seated Passenger

On the electrified lines of the Long Island Railroad, passenger traffic conditions are such that a considerable increase in equipment is required during the summer months. This increase amounts to about 25 per cent of the equipment in service during the remainder of the year. An order of 20 trailer cars, built by the Standard Steel Car Company, has recently been placed in service, in the design of which full advantage has been taken of these conditions not only to produce a car of exceptionally light weight, but to secure a maximum carrying capacity for a moderate outlay and to reduce to a minimum the investment tied up in idle equipment during the winter months.

The use of trailers was decided upon after a general survey of the traffic and operating conditions, it being estimated that three trailer cars could be built for approximately the cost of one fully equipped motor car. Furthermore, where motor cars only are used, if the conditions are such that during a part of the year only a portion of the cars are needed, the service must be distributed over all the cars to provide for proper inspection and maintenance of the electrical equipment.

A number of restrictions were imposed upon the design at the outset. The Long Island's class MP-54 motor cars with which the trailers are to operate are each equipped with one motor truck driven by two Westinghouse No. 308 motors, having a normal rated capacity of 225 hp. each. It was required that the weight of the trailers should be such that the operation of one trailer car with three motor cars would be well within the capacity of the motors in express service. At the same time it was necessary to adhere to the general dimensions of the motor car as to height, length and width because of station platform requirements and to preserve the uniform general appearance of the train. The strength of the underframe and body was required to be at least equivalent to the strength of the standard motor cars with which they are to operate. Owing to the fact that additional equipment was needed for summer service only, it was feasible to reduce the weight and cost by the omission of the false floor, inside lining and provision for heating, and a car has been built which has a seating capaciity of 80 with a total weight of 63,000 lb., which is only 787½ lb. per seated passenger; a class MP-54 motor car weighs approximately 110,000 lb. and seats 71 passengers, the weight per seated passenger being about 1,550 lb.



Interior of the Long Island Steel Trailer

The cars are 64 ft., 5¼ in. long from face to face of couplers. The over-all width is 9 ft., 10¾ in., and the omission of lining and insulation has made possible an inside width of 9 ft., 9⅝ in. between posts with a clear width at the posts of 9 ft., 4½ in. An unusually wide aisle has thus been provided. The trucks are placed 39 ft., 9 in. between centers and the car has a total

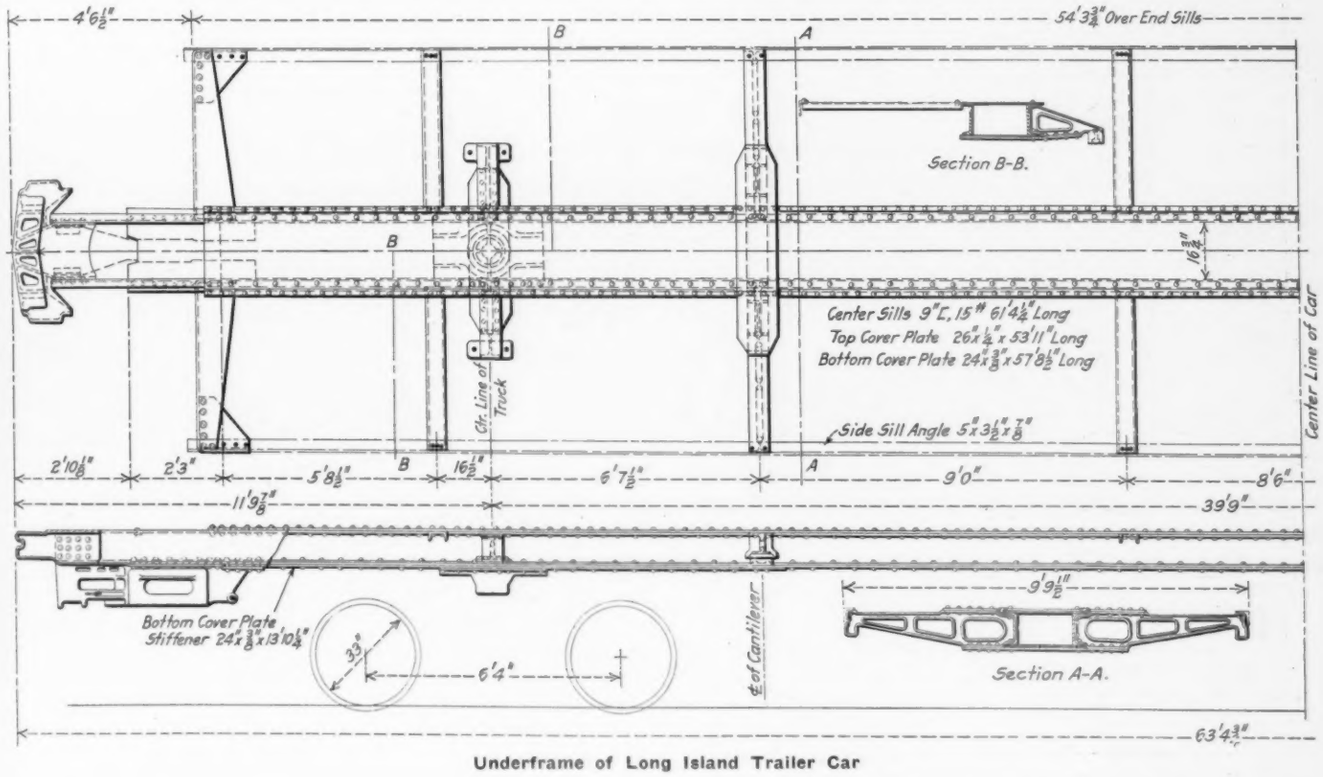
Steel Trailer Coach for the Long Island

wheel base of 46 ft., 1 in. The height from the rail to the top of the roof is 13 ft., the ventilators adding 8¼ in. to the clear height.

UNDERFRAME

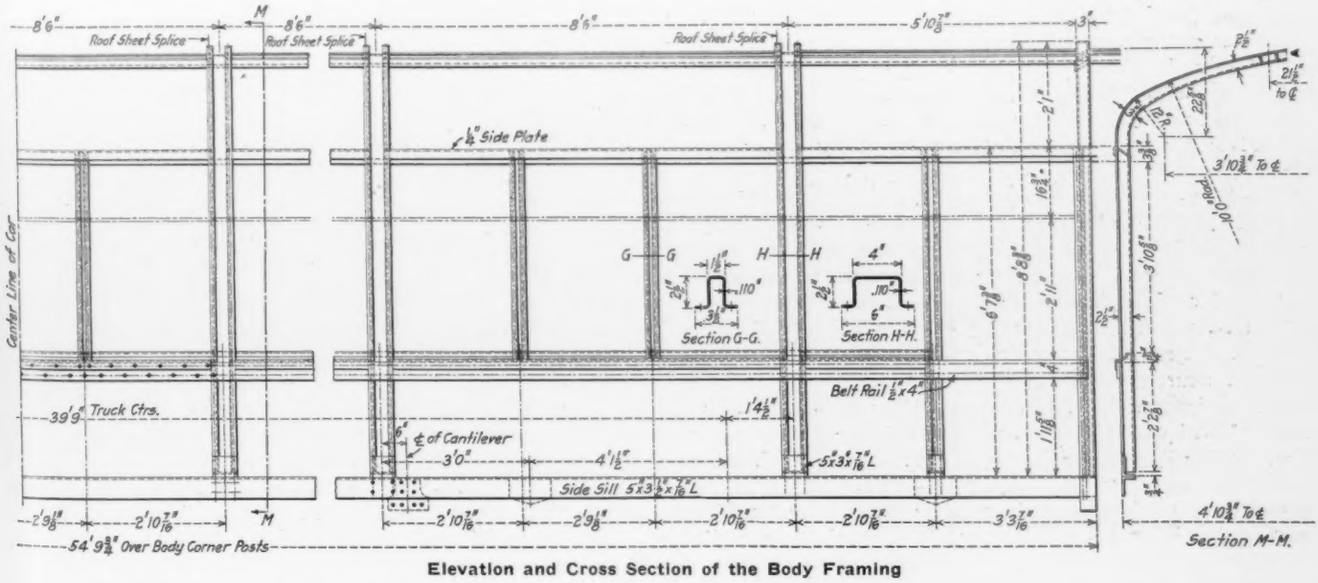
The principal member of the underframe is the box girder center sill, which is the same as that used on the motor cars. It consists of two 9-in., 15-lb. channels, 61 ft., 4½ in. long with top and bottom cover plates respectively ¼ in. and ⅜ in., in thickness. Cast steel draft sills, which take the Westinghouse friction draft gear, are secured to the bottom of the center sills. Cantilevers extending from the center sill to the side sills of the car are placed 13 ft., 3 in. on either side of the transverse centerline. Owing to the light weight of the body of the car, cast steel spiders have been used instead of the usual pressed steel construction, the webs being cored out to reduce the weight. The ends of the center sill are framed and riveted to the middle castings of three-piece platform end sills, the length over which is 63 ft. 4¾ in.

The side sills are 5 in. by 3½ in. by ⅞ in. angles placed with the horizontal flanges up in order that they may be used as a direct floor support. They are secured to the ends of the cantilevers and to the body end sills. Additional crossties are provided near the truck centers and at points 4 ft. 3 in. on either side of the transverse centerline of the car. These are of channel section placed flanges down and the ends are riveted to the horizontal flanges of the side sills and to the lateral projection of the top centersill cover plate.

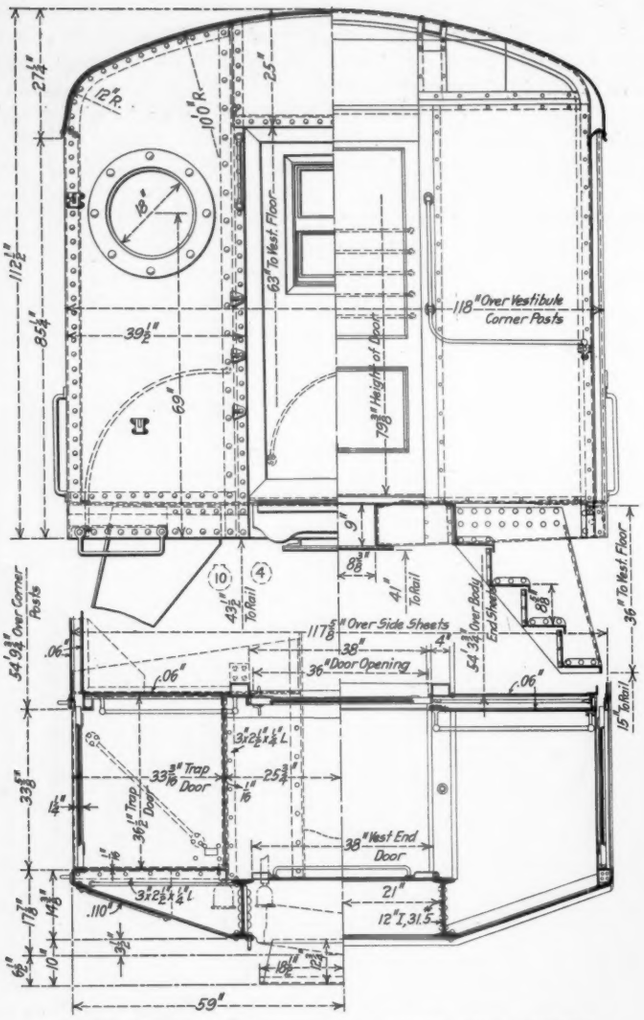


Underframe of Long Island Trailer Car

The body end sills are of pressed steel placed with the webs out, the ends of the web members being bent at right angles to



Elevation and Cross Section of the Body Framing



Vestibule Construction of Long Island Steel Trailers

the body of the sill and bearing against the vertical faces of the side and end sills. The top flanges are tapering, the wide ends providing ample strength and riveting area at the center sills. At the outer ends gusset plates are used to secure suitable connections to the side sills.

The trucks are provided with inside side bearings and the body side bearings are supported by cast steel struts riveted to the center sills and reinforced on the lower flanges by a transverse cover plate.

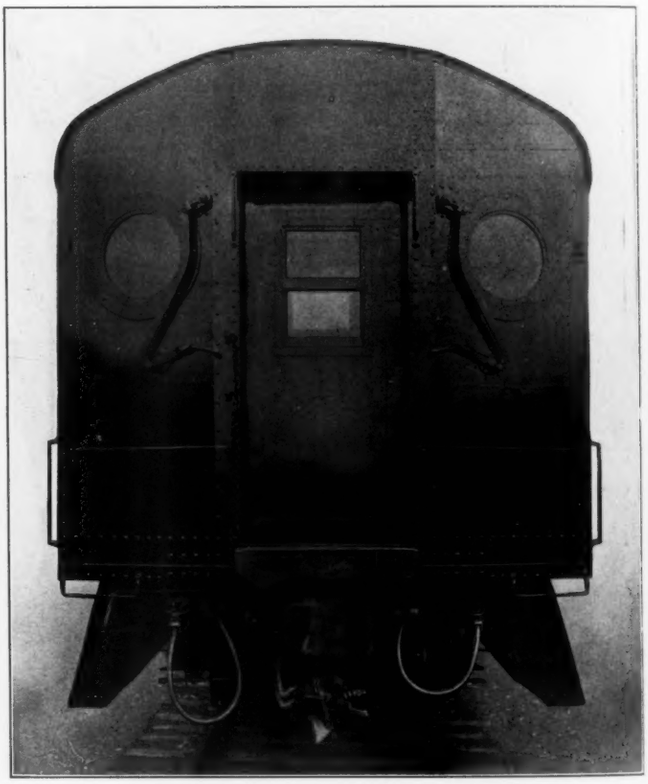
END CONSTRUCTION

In order to provide ample strength to resist the tendency to telescope in collision, 12 in., 31½-lb. I-beams were used for the vestibule end posts. These are placed between the middle and outer end castings, into which they are framed and riveted to the total depth of the casting. Beyond the platform end castings the end sills are of box section made up of pressed steel diaphragms securely riveted to the end sheets and platform corner posts, the inner ends being secured to the castings. The back side is closed with a cover plate to which the steps are riveted. The vestibule corner posts are pressed steel, ¼ in. thick and are of a special U-section with one leg longer than the other. They extend from the bottom of the platform end sills to the I-beam posts at the roof and serve as a riveting member for the vestibule end sheet and the roof sheet. The vestibule end posts are tied together by a pressed steel diaphragm which serves as a header for the vestibule end door and an additional tie is provided by the roof sheets.

The body end construction is made up of three truss members; two door posts of pressed steel box section and the combined body corner posts and carlines which extend from body end sill to body end sill. In common with the combined posts and carlines of the side frame construction this is made in two pieces to facilitate manufacture and welded on the centerline of the car, thus forming a continuous member. The door posts have the cover plate members extending the full depth of the end sill to which they are riveted, the U-shaped members being flanged and riveted to the top of the sill. The door header is of the same section as the posts and ties them securely together. They are further tied at the roof by the combined carline posts.

BODY FRAMING

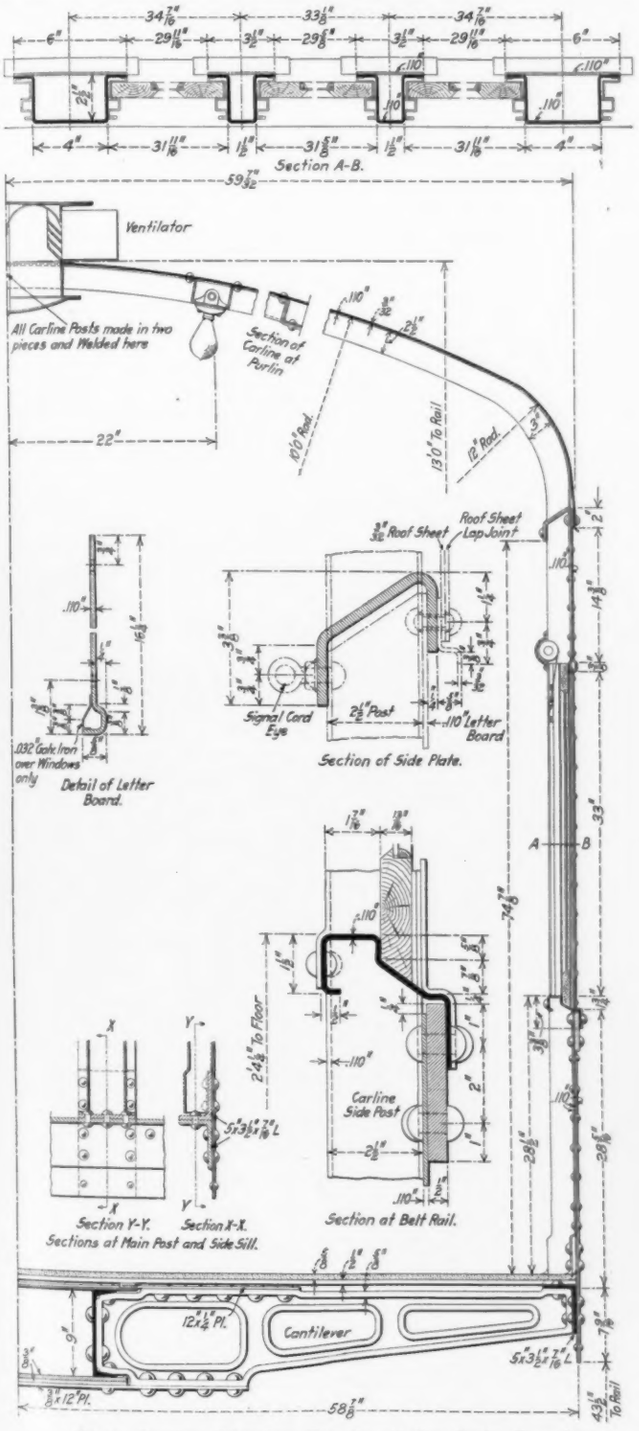
In order to reduce the weight and cost of construction the arch roof was decided upon. The posts and carlines are combined into single continuous members of U-section with the flanges turned outward for riveting to the side and roof sheets, an arrangement which produces a pleasing appearance on the interior of the car. Owing to the shape of the roof and the fact that but 3/32 in. sheets were to be used the carline construction was inadequate to support the sheets. Continuous pressed steel purlines were therefore placed 21½ in. on either side of the centre line. These extend throughout the length of the body from door post to door post. Where they cross the carlines they are pressed to the contour of the latter with the flanged portion of the section bearing against the leg of the carline and riveted to its bottom face. This construction not only gives strength to the roof and adds considerably to the longitudinal rigidity of the superstructure, but produces the effect of a beamed ceiling and adds to the pleasing appearance of the interior. These purlines are utilized to carry the conduits for the electric light wiring, the lamp sockets being secured directly to their lower face. In order to provide the maximum amount of longitudinal stiffness and to impart additional strength to the vestibule end posts and reduce their tendency to deflect at the roof under collision impact, the same spacing was used for the vestibule end posts, the body door posts and the carlines, thus bringing them all in line. Ves-



End View of the Long Island Trailer Showing the Permanent Jumpers

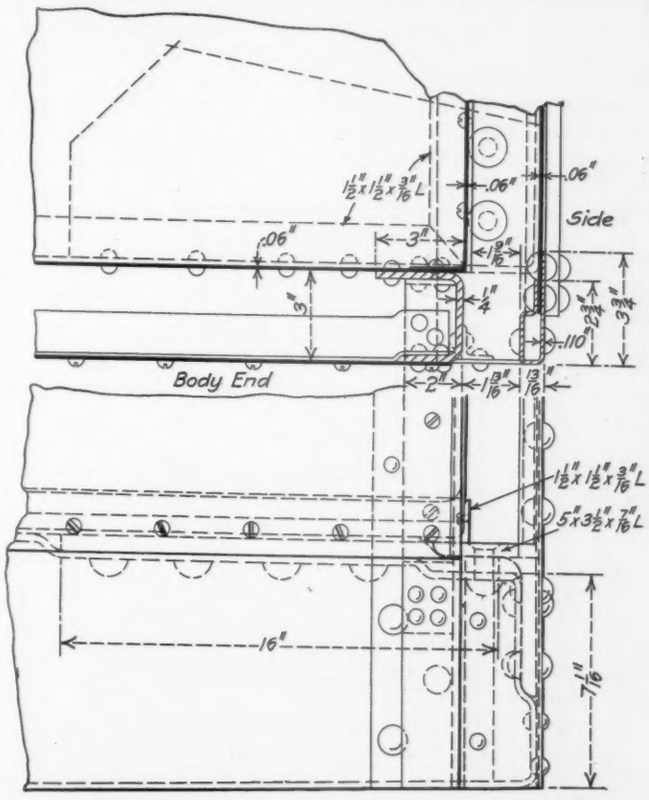
tibule purlines of the same section as those used in the interior of the car are placed between the vestibule end posts and the body end posts, and the vestibule is further stiffened longitudinally by increasing the thickness of the roof sheets from 3/32 in. to ⅛ in.

The length of the car body is 54 ft. 9¾ in. over the corner posts, and each side frame is divided into five side and two corner panels, the former being 8 ft. 6 in. long from center to center of carline posts, and the latter 5 ft. 10⅞ in. from the centerline



Cross Section Showing Details of the Body Framing

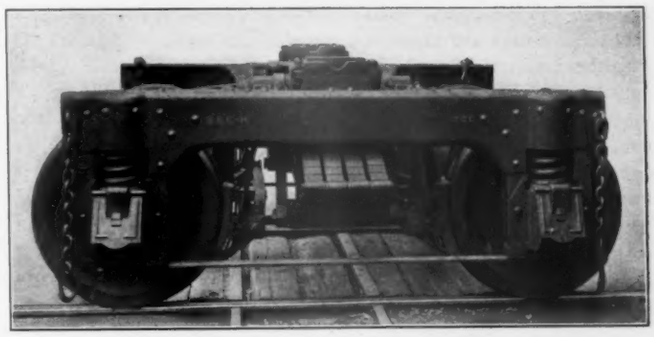
of the carline posts to the inside of the body corner posts. Each of the side panels contains three windows, which are separated by vertical members of U-section extending from the side plate to the belt rail. The corner panels each contain one window, framed by the carline post on one side and on the other by a U-section post extending from the side sill to the plate. A pressed steel window sill is attached to the carline posts and forms the bottom attachment for the vertical members between the windows in the side panels. It is flanged over the top of the belt rail and is riveted through to the side of the car. The belt rail



Connection of Body Corner Post and Body End Sill

is of rectangular section ½ in. thick by 4 in. wide and extends from body corner post to body corner post. The side plate is a special pressed steel U-section extending throughout the length of the car body. The web and outside flange are cut away at the side posts and the inside flange is riveted to the posts. The outside flange extends over the top of the letter board and is riveted between this and the lower edge of the roof sheets.

All framed members have been formed to produce a finished appearance on the interior of the car, and no interior finish



Four-Wheel Truck for Long Island Steel Trailers

has been used, with the exception of the pressed steel molding which covers the curtain rollers just above the tops of the windows.

TRUCKS

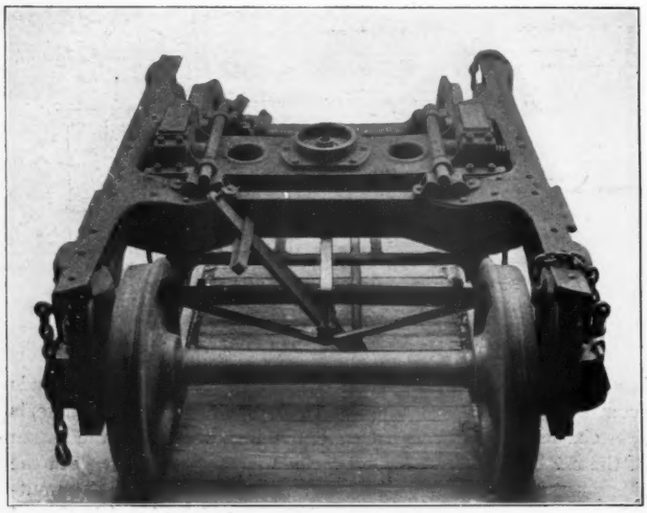
The cars are equipped with four-wheel trucks having a wheel base of 6 ft. 4 in. These trucks are of an unusually simple design and weigh 9,400 lb. each, complete. The general features of the construction are clearly shown in the illustrations. The side

frames and transoms are of pressed steel, while the bolster and spring plank are steel castings. By widening the flanges of the transoms at the ends and providing corresponding lateral extensions from the top side frame flanges, a very rigid transom and side frame connection has been secured and end rails are dispensed with. Steel pedestal castings provided with coil spring pockets are riveted to the ends of the side frames, which are specially formed to receive them. The truck is equipped with a light cast steel spring plank, which is suspended by swing links pivoted on the top of the cross frame. Both the bolster guides and the pedestals are fitted with wearing plates, which may be easily removed and replaced. The trucks are equipped with rolled steel wheels 33 in. in diameter, which are mounted on axles with 4¼ in. by 8 in. journals. Ajax metal bearings are used.

FINISH

The floor is finished with the railroad's standard top coated monolith laid in Ferro-inclave sheets. No false floor is provided.

The exterior of the cars is painted Tuscan red to conform to the Long Island's standard for passenger equipment. The interior is finished in white and light olive green, white enamel being used above the side plates and the olive green from the side plates to



Another View of the Truck

the floor. The seats are rattan covered and have no arms. They were furnished by Heywood Brothers & Wakefield Company, and are low enough to make possible the elimination of foot rests. The cars are ventilated by five Automatic ventilators set into the roof on the centerline of the car.

Since the cars are trailers no provision has been made in the vestibule for train control. The cars are provided with bus and control lines, however, for attachment to adjoining cars when operated in multiple unit trains. Current for lighting the cars is taken from the bus line.

In making up trains where detachable jumpers are used, considerable delay is often caused by the failure to find the proper jumpers at hand. In order to overcome this difficulty the jumpers are integral parts of the wiring of these cars and dummy receptacles are provided for holding the jumper head when not in use. This feature is shown in the illustration of the car end.

DESIGN OF STEAM PIPING.—Correctly designed steam lines skillfully erected are no more likely to fail and interrupt the service than other features, not duplicated. It is a matter of common experience that the hydraulic piping in a plant causes less trouble than the low-pressure house-service piping, because of the difference in installation. The same is applicable to steam piping.—*Power.*

INSPECTION AND MAINTENANCE OF AIR BRAKES ON FREIGHT CARS*

By ROBERT BARNABY

When a triple valve is removed from a foreign car for the necessary cleaning, lubricating, and repairs, the repairman removing the valve should sign and insert in the check valve case a card, noting thereon the initial and number of the car, the date and place removed, the make and type of triple valve, the initial of road, the date of last previous cleaning, and why sent to the shop. In addition to this the check valve case should be marked with red paint as a designating mark that this is a triple valve from a foreign car. This will insure prompt repairs.

The triple valve should then be forwarded without delay to the nearest test rack. Upon receipt of the valve at the test rack, the workman handling it will note that it is from a foreign car and he will remove the card from the check case and note thereon the work he performs and all material used in making repairs at the test rack or shop. After the repairs are completed, the slip that has traveled with the triple valve must be promptly forwarded to the office of the foreman holding the record of the other repairs performed on the car. This will enable him to prepare the necessary M. C. B. billing repair card, which will include all items of repairs shown on the slip. If the complete repairs cannot be made within a reasonable time, it is, of course, permissible to make up a repair card covering the cleaning, lubricating and testing of the cylinder; also the cleaning, lubricating and testing of the triple valve, and place a notation on the repair card, "Bill for repairs to follow," which means that an additional repair card can be made up covering the same car after a list of the repairs made to the triple valve are furnished to the foreman who has made out the first repair card.

The opening of the brake cylinder expander ring, when put in the cylinder, should be at the top and also that portion of the packing leather that was at the bottom should be turned to the top of the cylinder. The opening in the expander ring should not be less than ¼-in. or greater than ⅜-in., and the ring should have the ends properly rounded. A light coat of brake cylinder compound should be applied to the walls of the cylinder and packing leather with a suitable brush. The cylinder should not show a leakage of more than 5 lb. per minute with an initial brake cylinder pressure of 50 lb. Whenever cars are tested on shop or repair tracks, the brake cylinder must be tested and leakage reduced to 5 lb. per minute. This test should be made with a gage applied to the exhaust port of the triple valve in release position. All cars on shop, warehouse or teaming tracks should be tested regardless of the stenciling shown on the cylinder. No sharp tools should be used to help enter packing leathers in brake cylinder.

It is absolutely necessary to have the retaining valve, its pipe and connections, absolutely tight; if such is not the case, the particular car will not do its proportionate share of braking descending a grade, or when the retaining valve is supposed to be operated. No matter how tight a packing leather is, it is of no use if the retaining valve and its connections are not in good condition; on the other hand, if the retaining valve and all of its connections are in good condition, the retaining valve will give no service whatever if the packing leather is defective.

The car inspectors and repairmen whose duty it is to inspect and make light repairs to brakes and draft arrangements should also be required to give the same attention to hand brake defects, adjustment of brake rigging, brake pipe hangers, angle cocks, hose and couplings and pipe connections. The repairs should be made at the same time that other defects receive attention.

*From a paper read before the Niagara Frontier Car Men's Association, Buffalo, N. Y., May 19, 1915.

SHOP PRACTICE

OIL BURNING SAND DRYER

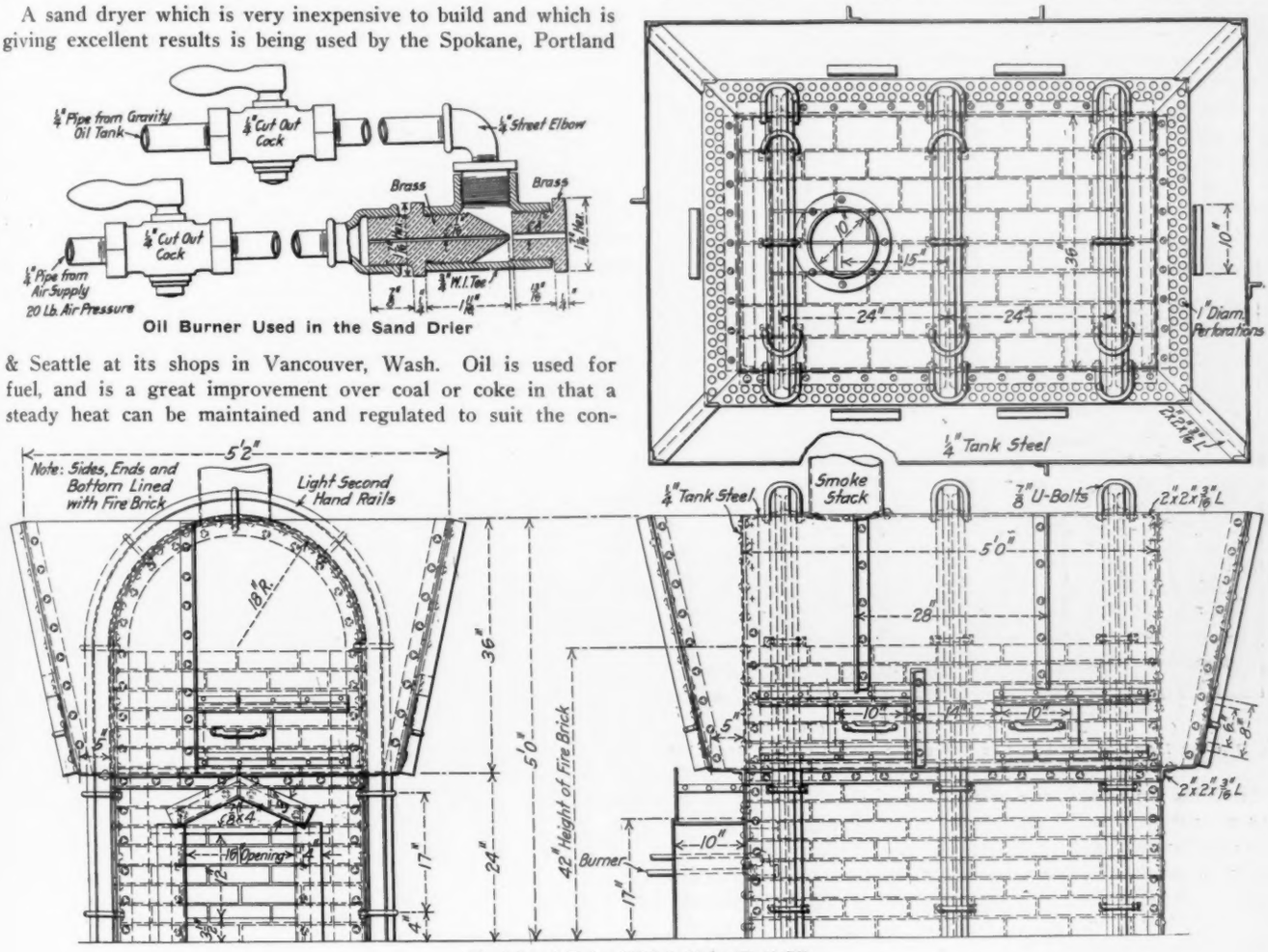
By F. G. LISTER
Mechanical Engineer, Spokane, Portland & Seattle, Portland, Ore.

A sand dryer which is very inexpensive to build and which is giving excellent results is being used by the Spokane, Portland & Seattle at its shops in Vancouver, Wash. Oil is used for fuel, and is a great improvement over coal or coke in that a steady heat can be maintained and regulated to suit the conditions, and in structure has outlived three of the ordinary cast iron type.

Oil Burner Used in the Sand Drier

The dryer is built with a frame work of three light rails lined on the inside with ¼-in. tank steel. The walls and bottom are lined with one layer of fire brick to a height 42 in. above the floor line. The hopper is made of ¼-in. tank steel joined at the corners with 2-in. by 2-in. angles, and the bottom is perforated with 1-in. round holes to allow the dry sand to run out. The sides and ends are provided with openings covered with sliding doors for the purpose of loosening the sand if packed, or to remove stones which might be lodged inside. The chimney is located in the front of the arch; the flame blowing in at the front door strikes the back wall and causes the gases to return to the front of the box and out the chimney, thus completely utilizing the heating surface of the firebox. The burner is made of standard pipe fittings, except the nozzle and two reducers which are made of stick brass.

The dryer is operated eight hours per day, three hoppers of sand being dried in this length of time. Eight gallons of fuel oil are consumed for each hopper full of sand. Air is supplied at a pressure of 20 lb. About four hours per day are consumed by the operator in handling the dryer and sanding on an average of twelve engines. The remainder of his time is spent in helping the hostler turn engines, etc. The dryer was designed and built by C. A. Landberg, general foreman of the Vancouver, Wash., shops of this company.



Steel Sand Drier Which Uses Fuel Oil

MANUFACTURING BROOMS

By B. N. LEWIS
Inspector, Shoreham Shops, Minneapolis, St. Paul & Sault Sainte Marie

Among the problems met in providing supplies for a railroad is that of securing brooms of a quality entirely suitable for the various uses to which they may be put. In order to provide better brooms their manufacture has been undertaken at the Shoreham shops of the Soo Line, and has given excellent results.

One of the greatest defects in the brooms usually purchased is that the corn soon becomes loosened from the handle, the brooms thus being short-lived. This has been overcome by extending the handle into the corn about six inches and applying metal bands in addition to the usual sewing. Three classes of new brooms are being manufactured. The common broom

shown at *A* in the illustration is used for ordinary sweeping. It carries only one steel band and is twine sewed. The band is squeezed into place in the sewing press and an eightpenny nail driven through it into the handle. It is then sewed with No. 12 gauge wire, passing through the band and the corn as shown in the illustration. The engine broom shown at *B* is especially designed to meet the requirements of the extra heavy service to which it is subjected. It is provided with two steel bands and no twine sewing is used; a bamboo insert is woven in with the corn when binding. This has proven a very serviceable adjunct. The switch broom is shown at *C*. Brooms of this type are made from reclaimed material returned to the shop, the worn end of the corn being cut off. This gives better service for track use than would new material.

The whisk broom shown at *D* is manufactured very cheaply by saving out the finest of the corn when sorting material for the manufacture of the other brooms. This saves purchasing a special quality of high priced corn sold for brooms of this kind.

(A) (B) (C) (D)
Brooms Manufactured in the Shoreham Shops of the Soo Line

Brooms are being made at a saving of the following amounts as compared with the market prices previously paid: common, five cents; engine, four cents; whisk, five cents. To secure a new broom the old one must be turned in. The handles of the old brooms are then reclaimed at a cost of $7.50 per thousand, which is less than one-third the price paid for new material. These handles are used in making engine brooms. The greatest saving is effected, however, by the increased service obtained from the brooms of our own manufacture. Their life is approximately double that of the brooms previously purchased in the market, this statement being based upon the decrease in the number issued.

This work is handled directly by the stores department; one man working on a contract basis furnishes all that are required by the road. The equipment required is inexpensive and consists of the following: winder, press, scrapper, drain board, tub and a cutting and sorting table fitted with a knife. The idea originated in the weekly shop foremen's meetings.

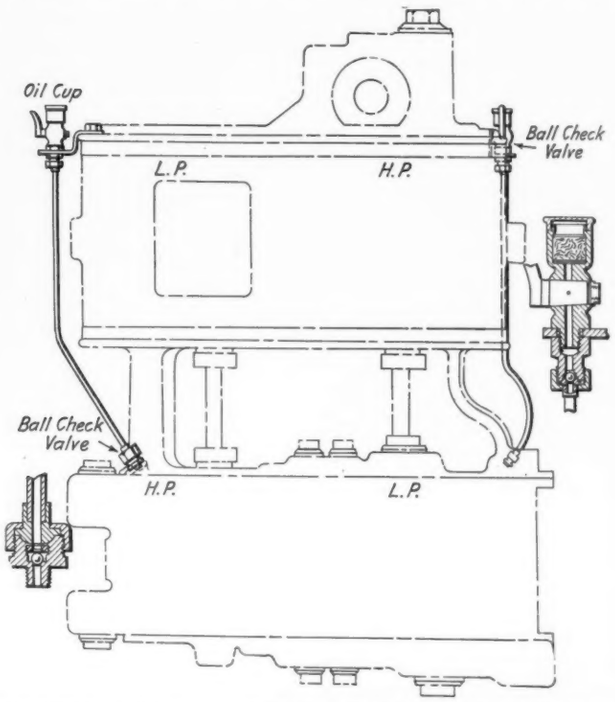
PERIPHERAL SPEEDS.—As compared with the 38 ft. per sec., which is considered the limit in safe speed for a cast-iron flywheel, some of the peripheral speeds attained by the disks of steam turbines are striking. In a paper presented to the Manchester Association of Engineers, R. F. Halliwell says: "The highest peripheral speed which it is possible to employ is probably found in the 300-h. p. DeLaval turbine, in which, with a 30 in. wheel running at 10,000 r. p. m., a velocity of over 1,300 ft. per sec. is reached."—*Power.*

OILING AIR PUMP AIR CYLINDERS

By E. A. MURRAY
Master Mechanic, Chesapeake & Ohio, Clifton Forge, Va.

The accompanying drawing shows a method of applying oil cups to the air cylinders of cross-compound air pumps which has a decided advantage over the usual application of these oil cups. The arrangement was developed by R. J. Bursey, air brake foreman at this point, and consists of the standard Westinghouse oil cup with a ball check placed in the pipe leading to the cylinder. The purpose of the ball check is to prevent back pressure from entering the oil cups. This makes it possible to oil the air cylinders at all times even though the pump has leaky discharge valves or worn packing rings. It saves a great deal of oil and has resulted in practically eliminating the practice of oiling pumps through the air strainer.

This arrangement has been in use for some time on the air cylinders of both cross-compound and 9½ in. pumps, and has given excellent service. As applied to the low-pressure cylinders of the cross-compound pump, the check valve is placed directly below the oil cup. In applying to the high-pressure cylinders the check valve is placed as near the cylinder end of the pipe as possible. It has been found that there is but a slight suction at the oil pipe connection at the beginning of the down stroke



Ball Check Valve in Air Cylinder Oil Pipes of Cross-Compound Air Pump

of the high pressure piston and it was therefore necessary to provide for the accumulation of a small volume of oil between the oil cup and the check valve.

With this device the cost of air pump repairs has been materially decreased and the efficiency of the pumps has increased perceptibly.

BRITISH DINING CAR SERVICE.—It is stated that all the railway companies are likely shortly to withdraw their dining cars. It must also be remembered that dining cars are luxuries provided by the force of competition. As each car weighs at least forty tons and there are generally two cars on all the northern main lines, their withdrawal would lead to a considerable saving in coal and set free a large number of young men to join the colors.—*The Engineer.*

RAILWAY TOOL FOREMEN'S ASSOCIATION

Reports on Special Jigs, Safety Pneumatic Tools, Grinding and Standardization of Reamers

The seventh annual convention of the American Railway Tool Foremen's Association was held at the Hotel Sherman, Chicago, Ill., July 19 to 21, inclusive, Henry Otto, tool foreman, Atchison, Topeka & Santa Fe., Topeka, Kan., presiding. Prayer was offered by Rev. O. M. Caward. The address of welcome was made by Robert W. Bell, general superintendent of motive power, Illinois Central. An illustrated lecture on "Getting the Most Out of Tools," was presented by B. W. Benedict, director of shop laboratories, University of Illinois.

ADDRESS BY R. W. BELL

From my observations and what I have heard, I have come to the conclusion that you tool foremen come here with a determined intention of acquiring all possible knowledge per-

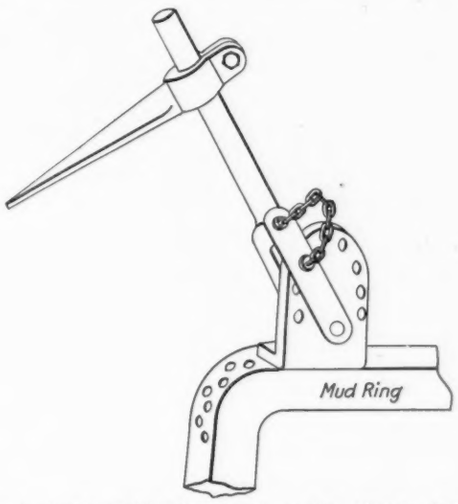


Fig. 1—Angle Drill Post Used on the Illinois Central

taining to your particular line of work. I realize that much good can be accomplished through an organization of this kind when the right motives prevail, and I am in hearty accord with the ideals for which you apparently are striving. Railroads are constantly facing new situations and dealing with new conditions. Progress demands the incessant interchange of opinions. We gain new inspiration and derive original viewpoints as often as we add to our acquaintances; therefore, the value and necessity of getting together and exchanging ideas. There is much to be accomplished in your line of work, and I am sure if you employ your faculties here at this convention you cannot fail to profit, and take home with you many valuable ideas, which will be of great benefit to you personally and to the road which you represent.

There can be no better plan for reducing shop costs than through efficient tool service, and it must be apparent to all that you tool foremen have a direct influence on the efficiency of the many workmen employed in your shops, who, if not supplied with good safe equipment to work with, are liable to waste much time, and in many cases, work under hazardous conditions. The importance of good tools in railroad shops was never before realized as it is today, and each year we find changes taking place in our locomotives and cars which demand that you be keenly alive to the situation, in order that repairs to such power and equipment may be quickly and properly handled. Some of you men, no doubt, are located at the smaller shops, where the making of tools is restricted, but I would impress on your minds the importance and necessity of keeping up-to-date.

There are probably no greater possibilities in any line of railroad shop work than in standardizing good tools and appliances for the work, and it should be your object to make the best of the opportunities afforded in coming together for the discussion of such matters. Railroads are not selfish in the matter of new and improved tools or methods, and each one of you who attend these conventions should be able to go home prepared to show how some jobs may be handled in a better and more economical way than before. The class of work turned out in a shop and the speed and manner of execution is not, however, wholly dependent upon fine tools; for the human element is bound to enter into this to a great extent. If you, through hard and diligent work, produce a new and efficient tool or device for doing a certain job, and it is turned over to a poor or careless workman, your time and his is very likely to be wasted unless the proper supervision is given to see that it is handled in the right way. You should co-operate with the other foremen and the men themselves, that your influence may tend to have a good effect throughout the shops.

PRESIDENT'S ADDRESS

To standardize and systematize our work means a gain for our employers and gives a better basis to the purchasing department for commercial contracts. In considering these activities of the association, that the construction of the association must be based upon information given by its members, I wish to call your attention to the fact that co-operation is the only

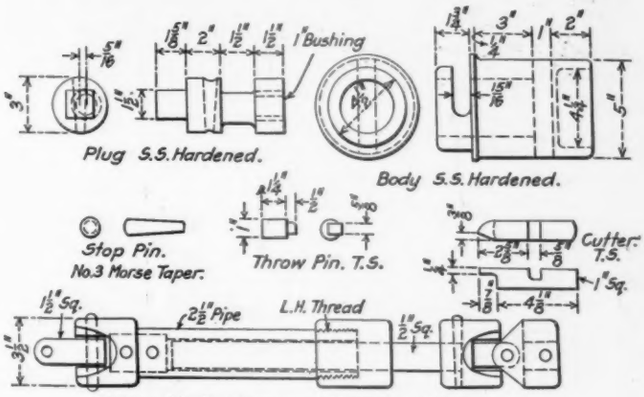


Fig. 2—Superheater Flue Cutter

road to success in our work. This association has grown to be recognized, not only by our employers, but also by the tool industries of the country. The manufacturers are interested in our progress. We are coming here once a year to hear the progress made with certain tools or methods. We are coming here to get something new to take home to our departments. It is a known fact that the men at the head of the tool rooms are the ones who find out what is needed to accomplish better work. It was for these ideals that we came together and formed this association. It is the expression of appreciation of the results obtained which encourage the extension of the work, and the main function of this association is to widen our knowledge.

SPECIAL JIGS FOR LOCOMOTIVE REPAIR SHOPS

C. A. Shaffer (I. C.)—Fig. 1 shows a new type of angle-drill post, which is obviously an improvement over the or-

dinary "old man." Its adjustable feature makes it especially well adapted for such work as drilling mudring corners. It can be built for practically the same cost as the old style drill post.

Fig. 2 shows a superheater flue cutter, with the accompanying telescope driving shaft and knuckle joints, which has been working very satisfactorily on the Illinois Central. It is driven by

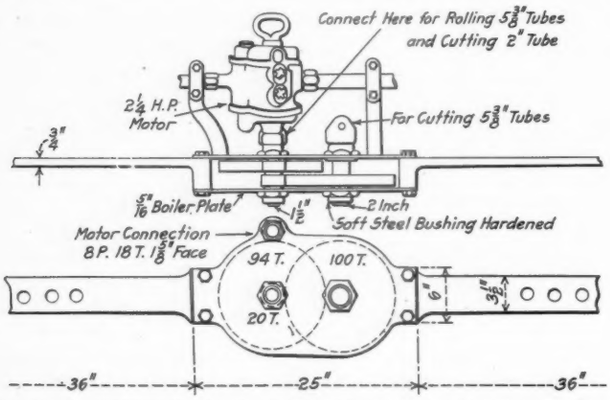


Fig. 3—Apparatus for Driving Tube Cutters in Locomotive Front Ends

the gearing arrangement shown in Fig. 3. This arrangement is also used for rolling tubes. It is secured to the front end of the locomotive, as indicated. The motor drives an 18-tooth pinion which in turn drives a 94-tooth gear. To this gear is rigidly attached a 20-tooth pinion, which drives a 100-tooth gear. Two connections are provided for the driving shaft to the tool, the first gear reduction being used for rolling the large tubes and cutting the small, the second gear reduction being used

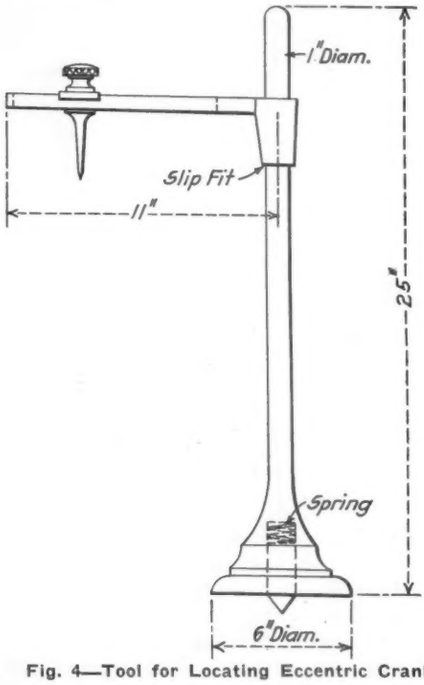


Fig. 4—Tool for Locating Eccentric Cranks

for cutting the large tubes. The casing for the gears or the side bearing plate for the gears also furnishes a neat and safe covering for them.

Fig. 4 shows a tool for locating the eccentric crank on outside valve gear engines. It resembles a surface gage, the face being 6 in. in diameter, resting on the end of the driving axle, a spring center fitting into the center of the axle. The arm, 11 in. or more in length, as desired, has a sliding fit on the upright, a gage point being adjustable on the arm. To provide the proper throw to the eccentric the gage point is set at the required distance from the center of the upright and the tool is placed on the end of the axle. The eccentric crank is then turned on the crank pin until the center of the crank engages with the gage point. It is then rigidly clamped to the crank pin.

Fig. 5 shows a very convenient arrangement for use in boiler shops to transfer the height of the crown sheet to the head of the boiler. It consists of a plug which is inserted in a tube somewhere near the level of the bottom of the fire door. This plug supports, by means of an adjustable screw, one end of a straight edge, the other end on the edge of the fire door. After the boiler has been leveled with the frame the straight edge is leveled with the frame by means of the adjustable screw at the tube sheet end. The height gage, which is adjustable, is then set for the height of the crown sheet inside of the firebox. It is then removed from the straight edge, taken outside of the firebox and used to locate the boiler fittings.

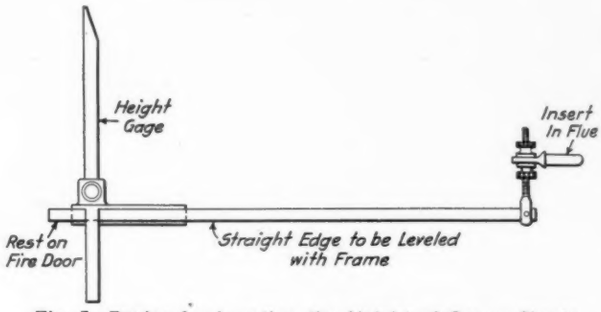


Fig. 5—Device for Locating the Height of Crown Sheets

Charles Helm (C. M. & St. P.)—Fig. 6 shows a jig for babbitting crosshead shoes. It was designed to eliminate the necessity of planing the shoes after the babbitt had been poured. The bottom member of the jig, *A*, is made of steel and is machined all over. It consists of a flat plate with vertical flanges running part of its length. At one end there are lugs which form part of a hinged joint. Parts *B* are guides for the shoe and are bolted to either side of *A*, as indicated in the elevation; *C*, is bolted to the inside end of the vertical flanges on *A*, and serves as a rest against which the shoe is placed. In *A* there are 2½-in.

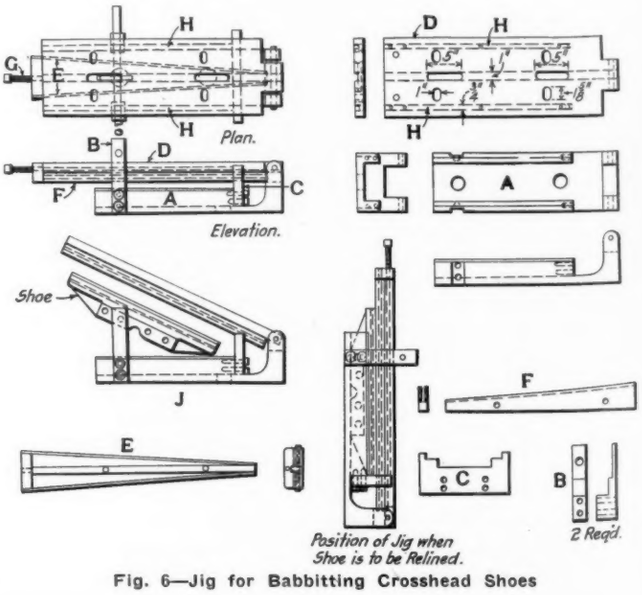


Fig. 6—Jig for Babbitting Crosshead Shoes

holes through which a stick is run for making the oil holes in the babbitt of the shoe. A flat plate, *D*, serves as a cover and is hinged to *A*, as indicated. It has two slots, 5-in. by 1-in., into which shoulder bolts in *E* enter for holding *E* and *D* together; *E* is held central in *D* by a tongue which fits in a groove running

the entire length of *D*. It is a wedge-shaped forging, machined all over. Dovetailed tongues are machined, as indicated on the sides. These fit into corresponding dovetailed grooves in *F*, which is also clamped or bolted to *D* by four shoulder bolts passing through the four 1-in. by 1⅝-in. holes in *D*. The purpose of this construction is to permit of regulating the width

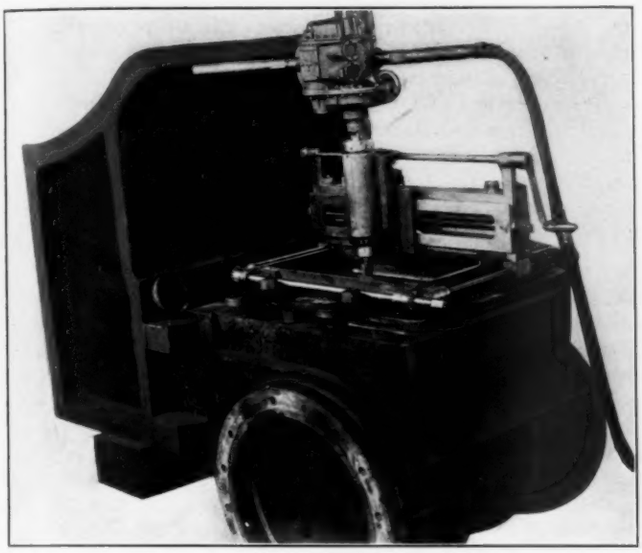


Fig. 7—Valve Seat Port Miller

of the babbitted surface in the shoe to allow for the lateral wear of the guide. On the end of *E* there is a flange, as indicated, provided with a tap hole. Through this hole is screwed the regulating screw *G*, by which the adjustments are made. After the correct width has been obtained, *E* and *F* are securely bolted to the top *D*. On the lower face of *D* there are two ¾-in. by ¾-in. grooves *H*, into which are inserted corresponding pieces, which are held by set screws, for the purpose of

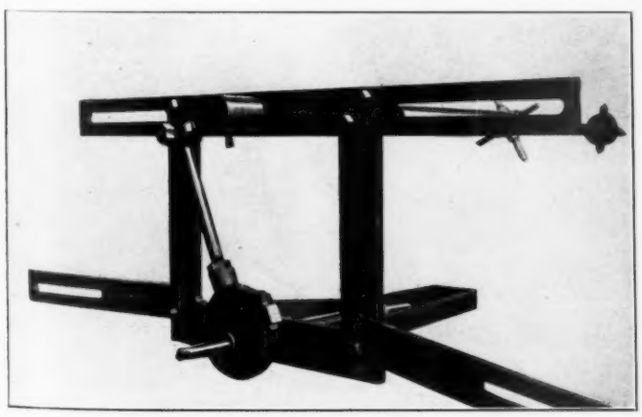


Fig. 8—Jig for Grinding Dry Pipe Joints

covering the side of the shoe to prevent the babbitt from leaking out of the jig.

The crosshead shoe to be babbitted is placed in the jig, as shown at *J*. It rests on the bottom piece *A* and the top piece *D* is dropped into position. A rod is passed through the holes in the uprights *B*, and a wedge driven between the rod and the top *D* to hold the shoe firmly in position. The jig is then turned up on end, as indicated, and the babbitt metal forced in. When the babbitt is cold the shoe is ready for application to the engine, no machining being necessary.

C. T. Brunson (Wabash).—The tool room should be looked on as the economic center of the shop, the place to go to get the cost of production cut, and a place where every dollar spent usually saves many more. Among the interesting and time-saving devices at the Decatur shops of the Wabash is the valve steam-port miller which is shown in Fig. 7. This is used for milling steam ports in valve seats on slide valve engines, and for milling keyways in axles. The frame was made from an old steam chest, and the balance of the machine from the forgings and castings to be found around any locomotive shop. The cross rail is fed along the base of the machine by lead screws on each side, being operated by one shaft through bevel gears. The milling tool is driven by an air motor applied to the taper spindle.

A special radial attachment has been applied to the large planing machines for planing the fit of the cylinder saddle to the radius of the boiler. A column is mounted on top of the machine and to one side, which supports a pin on which the radius bar rotates. The other end of the radius bar is connected to the top of the tool head, which is allowed to slide freely up and down. The head is clamped at a small angle from the vertical in order that, as the tool head moves across the rail, it may be free to slide up or down, as the case might be, responding to the pull of the radius rod. In setting up the cylinders to operate with this device it is necessary that the center of the cylinder saddle come very nearly below the center of the pin of the radius rod. By increasing or decreasing the length of the radius rod, any desired radius may be obtained, and it will be seen that as the

Fig. 9—Reamer for Throttle Valve Seats

tool move away from the radius pin it will be raised in the tool post, thus making very nearly a true circle. This has been found to be a much easier method of preparing the cylinder saddle for the boiler than chipping.

Fig. 8 shows a jig for grinding the joints between the dry pipe and the front tube sheet. The frame is bolted across the front of the smoke box, and an air motor is used to drive the eccentric. The eccentric rod attached to the grinding shaft gives it an oscillatory motion, permitting the joint to be ground as if by hand. The shaft between the frame work and the dry pipe joint is adjustable. A mechanic and helper can grind the worst dry pipe in an hour with this jig and the motor does the work.

Fig. 9 shows a reamer used for boring and facing the seat of throttle valves for large engines. The job was previously handled on a boring mill and was very difficult, taking about 3½

hours to do the work. With this reamer the work is done on a radial drill and can be finished in about 20 minutes.

Beading tools made of high speed steel have been found to be expensive, and the life of the tool is very short, due to the brittleness of the steel and the variation in the temper. These are now made of vanadium alloy steel, which costs approximately 15 cents a pound. The cost of production has been reduced by about two-thirds and the average life of the tool is longer.

Fig. 10 shows a drilling device for drilling holes in the side sheets of locomotive boilers. It is virtually a portable drill, being operated by an air motor. The motor is held on a geared head operating on a lead screw supported on a large frame, which is sufficiently heavy to give the proper stability. The

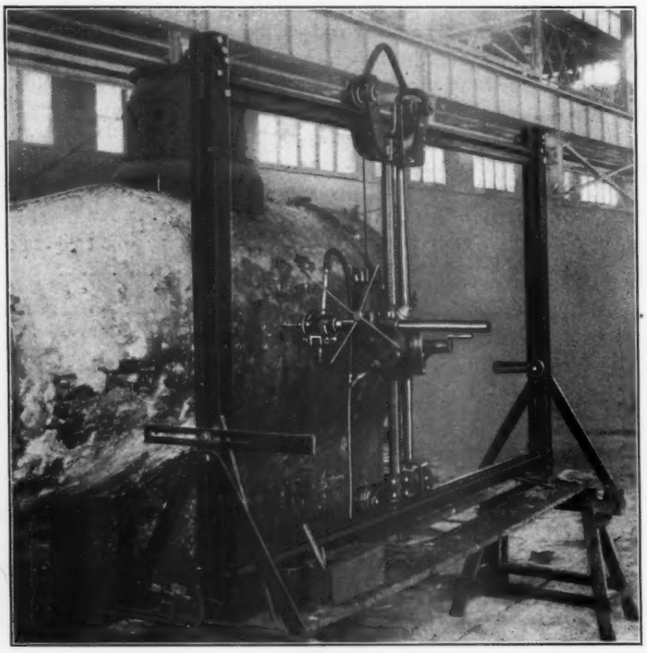


Fig. 10—Arrangement for Holding Air Motors for Drilling Boilers

motor may be raised or lowered as desired, provision also being made to clamp it at any angle to the spindle. Chains are sometimes thrown around the boiler, as indicated in the photograph, for greater stability. This has been found to be of greatest convenience in drilling staybolts, studs, etc., in side sheets. We also use a gang punch for punching jackets, 18 holes at one blow, with equal spacing.

B. Henrikson (C. & N. W.)—The Chicago & North Western has eliminated the key type of crosshead, and is now using the design in which the piston rod is held in the crosshead by a large castle nut. Fig. 11 shows the dies for making both the blank and castle nuts, the dies being made in this case to fit a 6-in. Ajax forging machine. The dies are sectional, and each half die consists of seven distinct pieces. The main body of the die is made of cast iron; the remaining pieces may be either soft steel or tool steel. If they are made of tool steel they should be tempered, and if made of soft steel they should be case-hardened. As will be noted, the outside plate is recessed to carry another plate, the object being to facilitate the replacement of the outside plate in case of accident. The parts are bolted to the main body of the die by 1-in. studs. The bar is upset in the bottom recess of the die and the castellations formed. In the top recess the center is punched out, completing the blank nut. Only one heat is necessary to do this work. From 3½-in to 4¼-in. nuts may be made with these dies.

DISCUSSION

A number of interesting devices were described, a blackboard being provided for making sketches. A method of making split keys from flattened scrap tubes was mentioned by Mr. Shaffer, of the Illinois Central. After the tubes have been flattened they are punched to shape, leaving the bend at the side of the tube caused by the flattening, to hold the keys together. An ingenious home-made universal joint which was of simple construction was mentioned by one member. It consisted of two U-bolts linked together and fitting in the shafts, being held in the shafts by set screws. Several members spoke of their success with inserted tooth reamers, holding the teeth by caulking. It was believed, however, that they should only be used in reamers of 1¾-in. diameter and over. Inserted tooth taper reamers were made with lugs at each end of the teeth to fit in corresponding pockets in the body of the reamer, to prevent climbing out. A successful inserted tooth taper tap was also mentioned as being of special advantage in reaming out and tapping blowoff cock holes.

SAFETY FIRST

E. J. McKernan (A. T. & S. F.)—There has been a large amount of money spent in making safety improvements in order to eliminate personal injuries to employees, but this cannot be accomplished unless the co-operation of each and every employee is obtained. While the men are showing more interest in the matter there is still need for greater co-operation. When an employee sees anything hazardous or unsafe he should make a special effort to notify the proper party so that such conditions can be remedied, not only for his own protection, but for the protection of his fellow-workmen. In many instances employees bring accidents upon themselves by being careless and placing themselves in danger when they could easily avoid it. The shop should be maintained in a clean and sanitary condition as an unhealthy man is more liable to be careless and thus injure himself or his fellow workmen. When employees find it necessary to pass through railroad yards in going to and from

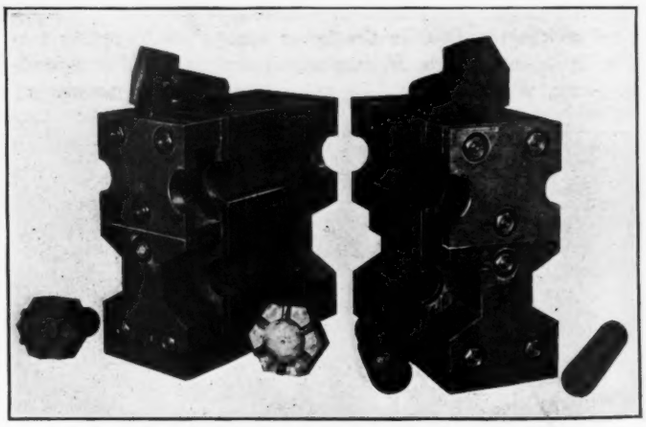


Fig. 11—Dies for Forming Large Castle Nuts

work there should be positive instructions forbidding them from hopping on and off moving locomotives and cars.

In applying or removing belts from various machines throughout the shops, employees other than those assigned to this work should not be allowed to handle them, as serious accidents have occurred to those who are inexperienced. Too much care cannot be exercised in mounting and taking care of grinding wheels. There have been numerous accidents caused by the following: Improper inspection of wheels; wheels mounted on improper sized spindles; wheels mounted with only one flange; flanges having uneven bearings causing wheels to crack; flanges of different diameters; loose emery wheels; improper method of truing up the wheel; forcing wheels on taper arbors; wheels running at improper speed; wheels running out of true, and improper rest used for emery wheels permitting the work to pass down between the wheel and the rest. It has been found to be bad practice to allow any emery wheel to be im-

mersed in water, especially where half of the wheel is immersed and the other half is not. This throws the wheel out of balance. It is also bad practice to grind on the side of an emery wheel. The threads on the spindle of an emery wheel should run in the opposite direction to the way the wheel runs, as the nuts will become loose and the wheel is liable to fly off the arbor. Care should also be taken to see that the driving belts do not become crossed. Men who are called upon to do a large amount of grinding on emery wheels should be provided with goggles.

The following items should be watched carefully to prevent accidents: Projecting set screws; walking under loaded cranes; using weather-worn or oil-rotted rope for lifting heavy loads; using defective chains or hooks; permitting tools to be left where they may fall on the heads of workmen; use of defective hammers and sledges; splitting nuts with a chisel; wearing gloves when operating machines, and wearing loose overalls; passing in front of locomotive boilers when tubes are being removed; loose brick or cinders on overhead walls; shooting out of frame bolts with dynamite during working hours; defective shop floors, and the use of chipping hammers for driving in reamers. We have been able to materially reduce the number of accidents by the adoption of the safety attachment on sectional expanders, eliminating the possibilities of the pin flying out and thus injuring the operator.

Gust Gstoettner (C. M. & St. P.)—To overcome dangerous conditions it is necessary that the co-operation of the men be obtained. Cleanliness and tidiness should be one of the first rules. The emery wheel protection hood, including an adjustable glass for protecting the employee, is a very good safety device, for, as a rule, the men will not always wear the goggles when doing this work. In making guards for machinery they should be constructed at as low a cost as practicable. Common sense and a little good judgment by the operator himself are required to make "safety first" a success.

R. B. Fletcher (Belt Railway of Chicago)—A large number of machine manufacturers have altered the construction of their machines in order to reduce to a minimum the possibilities of injury to operators. One very important factor in the elimination of injury to shop employees has been the adoption of motor driven machinery. The special controlling features for machines have also added a great deal to the safety of shops. The tool foreman is in a position to greatly assist in the "Safety First" campaign by being sure that unsafe tools are not passed out to the workmen. Every effort should be made by the foreman, as well as the safety committee, in encouraging the men to report all unsafe conditions.

From a study of accidents it has been found possible to eliminate only 50 per cent. of the injuries by guarding the machinery; the other half are the direct result of carelessness by the men and must be overcome by the education of each individual workman. A great deal can be accomplished in this direction by closely watching the actions of each new employee to see if possible whether or not he is inclined to be careless. Careless employees should be carefully instructed and warned against danger.

George Nutt (C. G. W.)—It is the duty of every employee to report dangerous conditions immediately. Machinery should be kept in proper condition and grinding wheels inspected regularly, to see that the speed has not been altered or improper flanges substituted or the hoods removed. The average grinding wheel is not broken under fair usage. Other safeguards which will help to eliminate accidents are good lighting, whitewashed walls and ceilings, which serve a double purpose, as they are sanitary and help to provide plenty of light. The gangways should be kept clear and the floors, especially around machinery, should be kept in good condition. It is a good plan to post bulletins as accidents happen, stating how they happened and making comment on them, showing how they could have been prevented. By doing this the employees will become interested, especially when a fellow workman is hurt, and will undoubtedly look out to see that he does not get injured in the same manner.

DISCUSSION

W. G. Reyer, general foreman of the Nashville, Chattanooga & St. Louis, was called on to make a few remarks at the Tuesday morning session. He spoke of the importance of the tool foremen and of the opportunities they have for increasing the efficiency of all railway shops. He dwelt on the necessity for all those in charge of men to study their human characteristics with a view of handling them with the least friction and with the best results for the company. Speaking on the subject of "Safety First," he spoke of the necessity of operators using goggles where their work required it, and of the necessity of obtaining a glass for the goggles that would not break easily. Clear aisles in any shop are essential and protruding nails in the flooring should be carefully guarded against. He called attention to a sign that he had seen in some shop stating, "Safety First is all right, but a careful man is essential."

Other members, speaking of goggles, stated that it had been found difficult to have the men wear them consistently. One member said that an employee using an emery wheel without them should be disciplined. Various methods are adopted to keep the goggles in an antiseptic condition. Some use a mixture of alcohol and water; others use a steam cylinder, while some use a mixture of one-half wood alcohol and one-half water for sterilizing, and then rinse the glasses in plain water. Several members objected to the lack of goggles for use with eye glasses, stating that in those on the market to-day the shield does not extend far enough back to fully protect the eyes.

Many members spoke of the necessity of obtaining the co-operation of the employees in order to get the best results from the "Safety First" movement. The men should be made to feel the necessity of their individual help. On some roads the members of the safety committees serve only three months, in order that the spirit may be infused in as many employees as possible.

It is necessary to carefully inspect all chisels and flatter heads to keep them in proper condition. Some roads do this every morning and find that it is far better to grind off the heads than to have them dressed by the blacksmiths. The following are some of the special safety features reported:

Use paint brushes for wiping the chips away on milling machines.

Use a fine wire netting under balconies to prevent material falling into the machines on the main floor.

Steel blocks recessed to receive the frame are used on some of the heavy locomotive cranes.

Stand behind milling cutters, not in front of them.

Paint the sides of emery wheels to prevent the men grinding on the sides.

Platforms fitting over the top of the boiler, and which can readily be handled by cranes, are serviceable for removing dome caps.

Recessed collars shrunk on the chuck of wood boring machines, and large enough to cover the set screws, are being used by several roads.

Use portable screens.

Use only headless set screws.

Bolt plates into spoked gear wheels.

Apply springs to the flap of fast running shapers to keep the tool down, and thus eliminate the necessity of the operator using his hands for this purpose.

Leave the paper disc on emery wheels.

MAINTENANCE OF PNEUMATIC TOOLS

J. J. Sheehan (N. & W.)—When the delicate construction of the working parts of the pneumatic motor and hammer and the narrow margin between efficiency and inefficiency are considered, it will be found that there are no tools in the shop that receive harsher treatment.

Facilities must be provided for the removal of water and dirt from the air before it enters the pneumatic machine. The removal of water can be accomplished by having a suitable sized settling tank provided with a drain valve, close to the point of operation. The most effective strainer for keeping the dirt out of the tool is that made of a double thickness of muslin placed in the air line back of the tool. The pneumatic tools must be kept properly lubricated. On the Norfolk & Western

a satisfactory and cheap lubricant has been found in mineral lard oil, one containing marked emulsifying properties. Drills and hammers should be standardized as far as possible, both in styles and sizes, as it makes the maintenance easier and a smaller number of repair parts are required.

A simple arrangement for holding air drills while they are being repaired consists of a plain screw jack which has outlived its usefulness as a jack. The handle of the drill may be placed in the hole in the head of the jack and clamped with a set screw inserted at the top of the jack. This will readily permit of holding the drill firmly in any one position desired. It is important to know, after a drill has been overhauled, what per cent. of its rated energy it will exert. Fig. 12 shows a method of making a rough test for this purpose. A hydraulic

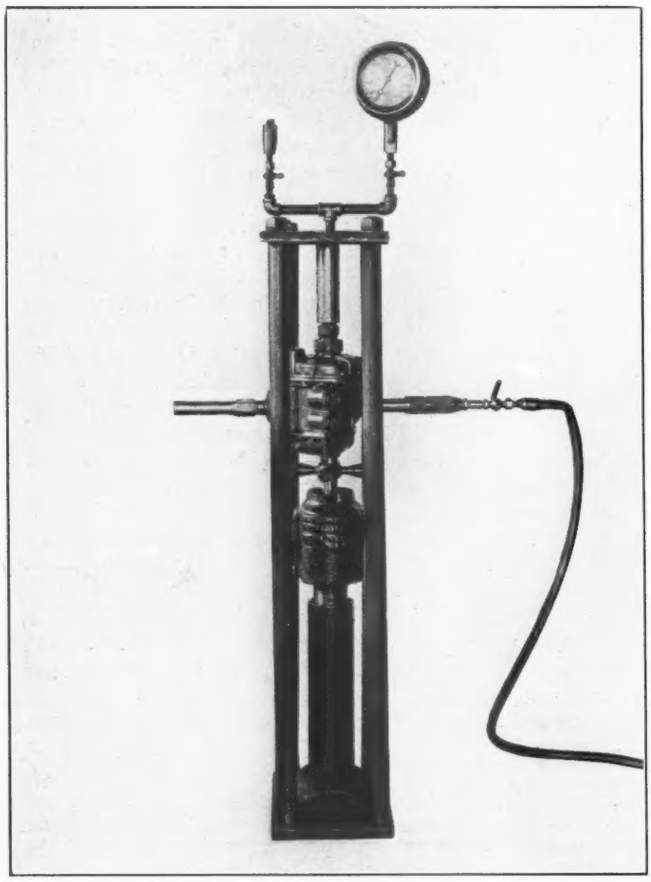


Fig. 12—Apparatus for Testing Air Motors

jack is placed in a frame in which is placed the pneumatic drill. A hardened friction ball is placed in the drill socket and runs in the corresponding friction bearing in the top plate of the frame. The pressure cylinder of the jack is connected to the gage at the top of the frame. After the motor is started the feed screw is screwed down on to the jack, increasing the friction of the ball in the socket, thus giving a combination of torque and thrust, exactly what occurs in feeding a twist drill. The area of the contact between the ball and the roughing surface may be regulated to give the friction desired. If the record of a drill of a particular class when new is 800 lbs. on the gage, this will be considered 100 per cent. efficiency. All other tests of the same class of drill are compared with the original record, and no drill is allowed to pass below 75 per cent. A drill failing to meet the required pressure is thoroughly examined for wear. In many instances the piston will be found to have been worn. It is expanded, by heating, .002-in., then a turned plug of the required diameter is inserted and the piston allowed to cool on the plug. The plug receives the heat from the piston, and after it is sufficiently cool, it can be easily removed, leaving the piston expanded the proper amount. Cylinders have also been closed on certain classes of drills by pressing through a block bored to the required size. This has produced satisfactory results.

In the pneumatic hammers it is found that if the valve casing is worn .002-in., the hammer will be unfit for service. In order to locate the difficulty in this respect a new valve is kept at hand to try the hammers. The valves are purchased .002-in. over size, thus allowing a certain amount of reaming to put them in working condition. It has also been possible to take worn valve casings and roll them in a sheet iron roller, closing them a sufficient amount to put them in serviceable condition. The joints between the head and the cylinder, and between the head and the valve casing, should receive close attention. When they become uneven and leak the facing tools shown in Figs. 13 and 14 are used to correct the trouble. The feed nut for the facing tool serves as a guide.

John B. McFarland (N. Y. C. & St. L.)—The air motors for the use of the boilermakers are kept in the boiler shop, and those for the machinists are kept in the tool room. Once a week they are filled with lubricant and inspected. The hammers are cleaned and oiled once a day when in use. We have overcome trouble with broken tangs on the square chuck sockets by cutting off the left-hand thread on the chuck, replacing it with a right-hand thread, and screwing on a nut. The other end of the nut is made to fit the threaded end of the motor, the nut tightening on a shoulder at the same time that the taper shanks tighten in the motor sockets. With the chuck fitted in this way it is possible to drive a square socket tool to the capacity of the motor.

In the small hammers a bushing with a taper hole is used, and a taper shank is made on all tools. The bushings are reamed out with a No. 2 Morse taper reamer, which leaves a hole

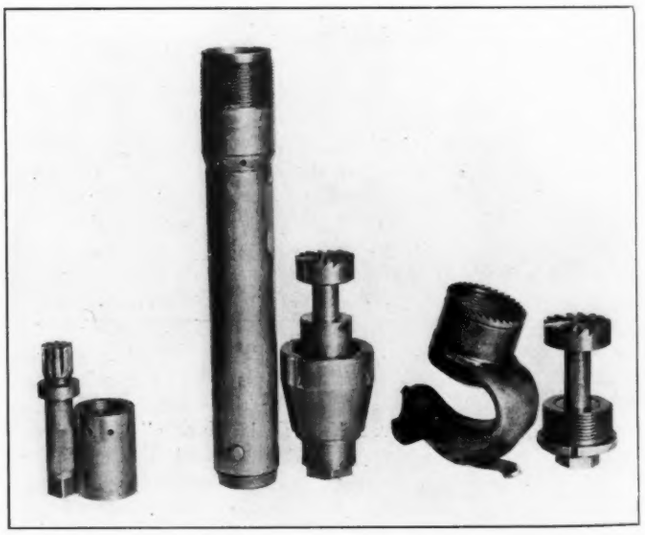


Fig. 13—Tools for Facing Air Hammer Connections

about ¾ in. on the large end and allows the use of ¾ in. octagon chisel steel for tools. This has stopped the breakage of shanks on such tools. A bushing will last from six months to a year before it becomes too large to impair the stroke of the hammer. This has been tried on large hammers with good results.

E. G. Nabell (Southern Ry.)—In selecting pneumatic tools, the economical operation and the cost of maintenance should receive the first consideration, not the first cost. As a means of producing better maintenance and higher efficiency from pneumatic tools the operators should be educated to use the tool that is best adapted for the work at hand, and to take

proper care of the tools, particularly with reference to dropping them or striking them with a hammer, or allowing grit or any foreign substance to get into the throttle of the machine when it is not connected to a hose. All pneumatic tools should be inspected and tested at regular intervals, cleaned and thoroughly lubricated with a good grade of lubricant. By keeping a close record of the repairs to the tools it will be possible to determine just what and how many repair parts should be carried in stock. When the tools are sent to the tool room for repairs they should be taken apart and thoroughly cleaned. An air hammer, when not in service, should be kept submerged in a good quality of light, clean oil to insure the thorough lubrication of all parts and prevent rusting. Where possible, it is desirable to confine the repair work on pneumatic tools to one mechanic who has become thoroughly familiar with the tools.

August Meitz (M., K. & T.)—It is a good policy to adopt a standard for pneumatic tools on any one railroad system. This would reduce the cost of repairs and maintenance about 50 per cent, as well as reduce the expense for repair parts to be carried in stock. The operators should be educated in the matter of the proper use of pneumatic tools; that is, they should use high-speed motors when they are required, and slow-speed

Fig. 14—Tools for Facing Air Hammer Connections

motors when they are required. Much damage is done to the motor, as well as to the tool, when this is disregarded. Good engine oil should be used to keep the motors lubricated, and it will also be found to pay to use some light grease, such as Keystone or vaseline, in the crank case. The motors should be kept in good repair and inspected regularly. It has been found to be good practice to place the hammer, after it has been in service, in a solution of gasolene and signal oil, mixed half and half, as small particles of rubber from the hose lining frequently lodge in the chamber between the handle and the throttle valve. The gasolene will cut the rubber, and by blowing the hammer out with compressed air the refuse and foreign substances will be removed.

DISCUSSION

It was believed that excessive oil in air compressors gets into the delivery line and gums up the throttle valves in the air hammers. Where this carbon deposit has been found some cut it out with gasolene, while others have succeeded in burning it out, the throttle being removed, and then washing in gasolene. Some roads insist that the men lubricate the hammers every hour; the hammers are assigned to the men and they are responsible for them. On the Santa Fe the air hose is inspected regularly and the air hammers are turned into the tool room for inspection every night. The men are required to remove the hose, and oil with a special oil that is provided, after the hammer has been used for a considerable time.

GRINDING AND DISTRIBUTION OF TOOLS

G. W. Smith (C. & O.)—On the Chesapeake & Ohio the tire turning tools, after having first been ground to the standard gage, are maintained by the operators of the lathe, an emery wheel formed to the standard shape being used for this purpose. For lathe, planer and brass work a chart is made showing the shape and class of work the different tools are required to do. For touching up lathe, planer and various other tools, general purpose grinding wheels are installed in different parts of the shops for the convenience of the workmen. The twist drills, however, are ground to a standard of 59 deg. in the tool room. The milling cutters and large reamers are ground in the tool room. Gear cutters, reamer cutters and tap cutters are ground on a dished wheel. With this style of wheel it is possible to grind to the bottom of the flutes with ease and a good cutting edge is obtained. It has been found that the dry grinding, if care is exercised and too heavy a cut is not taken, is better than wet grinding. Where water is used a large amount is necessary to prevent cracking the tool by over-heating the outer surface.

Each lathe is provided with a cupboard in which a reasonable number of standard shaped tools are kept. Many of the operators take care of their own tools. This same method is used for planer, shaper and slotter tools. Special tools for brass and turret lathes are kept in racks close to the particular machine, and when broken or dull are brought to the tool room for repairs. Twist drills and rosebit reamers are kept in the tool room in racks, and given out on checks.

J. C. Beville (E., P. & S. W.)—The wheel lathe tools are ground in the tool room. The round nose tool is ground with a 6 deg. clearance, 8 deg. back slope and 14 deg. side slope. The finishing tools are made to finish the entire width of the tire with one tool in one operation. They are ground with a 6 deg. clearance and an 8 deg. back slope. By grinding these tools in the tool room but little additional work was necessary, and it is believed that at least 25 per cent better work is obtained on the machine. All the other tools are maintained by the operator of the machine on which they are used. However, there is no doubt that better results could be obtained if these tools were ground by an expert, for it is a question whether the machine operators really know how their tools should be ground to produce the best efficiency. High speed steel is undoubtedly a fine material to use for such tools when they are hardened and ground properly, but in many cases carbon steel tools, if properly ground, could be used with as much success as the high speed tools improperly ground. This is a big field for the tool foreman to establish system in the handling of machine cutting tools. On the Chicago Great Western, at Oelwein, Iowa, the tool dresser is directly under the charge of the tool foreman.

J. C. Hasty (A., T. & S. F.)—Grinding machines should be kept as far away from other machinery as possible to avoid the dust getting onto the wearing parts of those machines. Where wet wheels are used care should be taken not to press the tool too hard against the stone, in order to avoid burning the steel, causing cracks to appear. The open grain dry wheel gives the best results for redressing high speed steel. All the lathes, planers, boring mills, shapers, etc., are equipped with a sufficient number of tools for the class of work performed

on the machine, each operator having a locker in which these tools are kept and locked when not in use. A man is appointed to take care of all machine tools, chisels, and chisel bars. He goes to the machine, collects all the machine tools that require redressing and takes them to the smithshop. He then grinds them and returns them to the workmen, no workmen being allowed to take their tools to and from the smithshop. When tools become short from redressing they are forged to smaller sizes, down to ½ in. by 1 in., for use in the tool holders.

DISCUSSION

While it was generally believed that much better results could be obtained in the machine shop if the tools were maintained by the tool room force, the practice on most of the roads seems to be to allow the machine operators to grind all but the very special tools. On the Wabash, none of the machine operators or machinists are allowed to grind the tools. The drill presses are equipped with tool boxes containing a set of tools which are charged to the operator. When they become worn they are exchanged at the tool room. Other roads provide similar systems, while some keep a complete set of tools at each machine, which are replaced when they become worn. On the Santa Fe, all the drilling machines are provided with a chart showing the speed and feed for each size drill to be used on the different kinds of material. This insures that the benefit of the high speed drill will be obtained without spoiling the drill. It was also pointed out that where high speed drills were used the work should be securely clamped to the table, in order to prevent the breaking of the drills under heavy cuts. Mr. Pike, of the Rock Island, reported success in welding high speed tips on soft steel tool bodies.

STANDARD REAMERS

The committee reporting on the standardization of reamers for locomotive repair shops recommended that all taper reamers in sizes under one inch be the commercial standard. In sizes over one inch, three overall lengths were recommended: 18 in., 20 in., and 28 in. The square shank on reamers ⅞ in. up to and including 1 in., was recommended to be ⅞ in.; on sizes from 1 in. to and including 1⅜ in., 1 in. square; on sizes over 1⅜ in., 1⅛ in. square. The length of the square was recommended to be 1¼ in., the length of the collar ¼ in., and the clearance between the end of the flute and the collar, ¾ in. The taper was recommended to be 1/16 in. in 12 in. The left-hand spiral was recommended, due to the fact that it will eliminate the feeding of the reamer too fast, and greatly reduce the number of breakages. On reamers under 1⅝ in., two flutes less than the standard were recommended, and on all sizes over 1⅝ in., four flutes less than the standard were recommended, the reason being that a much stronger flute and a longer life of the reamer will be obtained.

OTHER BUSINESS

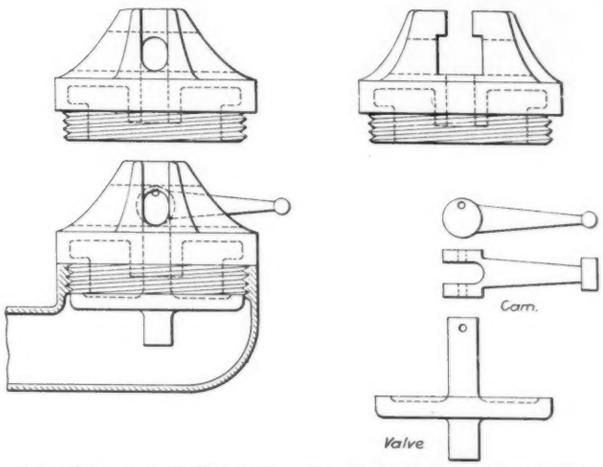
The secretary reported a cash balance of $90.16. The following officers were elected for the ensuing year: President, J. J. Sheehan, Norfolk & Western; first vice-president, C. A. Shaffer, Illinois Central; second vice-president, J. C. Bevelle, El Paso & Southwestern; third vice-president, C. T. Brunson, Wabash; secretary-treasurer, Owen D. Kinsey, Illinois Central. It was voted to hold the next annual convention in Chicago.

Setting Ahead the Clocks in Detroit.—In order to gain more daylight time, the industries of Detroit, Mich., have been placed on eastern standard time, all clocks having been pushed ahead one hour May 15. Cleveland adopted the eastern standard time about one year ago. It seems unfortunate that the cities of the Middle West cannot hold to central standard time. The confusion resulting from a difference of one hour between local timepieces and railroad time causes many travelers to miss train connections.—*Machinery.*

RELIEF VALVE FOR SUPERHEATER LOCOMOTIVES

By W. B. MIDDLETON
General Roundhouse Foreman, Atlantic Coast Line, Rocky Mount, N. C.

The lubrication of the cylinders of superheater locomotives when drifting is a problem which has presented considerable difficulty. Where relief valves are used the inrush of air when the throttle is closed causes carbonization of the oil, at the temperatures found in the steam passages; this results in the destruction of its lubricating qualities and the accumulation of carbon on the cylinder walls and in the steam ports. In many cases the use of the relief valve has been discontinued in order to prevent this action, with considerable benefit in the elimination of carbonization. But without the relief valve there is danger of the locomotive moving with no one in charge, owing



Cam-Operated Relief Valve for Superheater Locomotive

to the accumulation of pressure from a leaky throttle or to possible carelessness in the closing of the throttle.

In the drawing is shown a type of relief valve cap designed to retain the advantages of the relief valve at terminals, on storage tracks or at lay-over points, but to permit its positive closing while the engine is in service. Caps of this type may be applied to the valve bodies now in service. In the top of the cap is a milled or slotted tee slot into which the cam, shown in the drawing, is inserted. With the cam and valve in place the two are connected by a pin inserted through openings provided in the sides of the tee slot. The throw of the pin hole in the cam is equal to one-half the lift of the valve, and by throwing the cam from the position shown to the other side of the cap the valve is completely opened.

Cleaning Castings.—In a leading article in the *Electrical Review*, dealing with lubrication troubles, it is stated that the difficulty with new turbine and engine bearings is frequently attributable to the fact that manufacturers do not clean the castings properly. Castings are never properly cleaned of sand, even externally, by the still common methods of brushing and coke rubbing, and in steam ports and passages it is hopeless to expect cleanliness from such antiquated methods. The most effective way for removing sand seems to be to pickle the castings. First, they are roughly cleaned and fettled and then hosed with weak hydrochloric acid. When sand is present this spreads the acid by capillary attraction, and the result of a few hours of acid action is to remove all sand and to leave the surfaces clean and free from hard silicious scale. Afterward the castings are washed with warm water dosed with soda to neutralize any remaining acid.

THE GENERAL FOREMEN'S CONVENTION

Reports on Valves and Valve Gears, Shop and Engine House Efficiency and Oxy-acetylene Welding

The eleventh annual convention of the International Railway General Foremen's Association was held at the Hotel Sherman, Chicago, July 13 to 16, W. W. Scott, general foreman of the Delaware, Lackawanna & Western, presiding. The opening prayer was made by the Rt. Rev. Samuel Fallows, D.D., LL.D., presiding bishop of the Reformed Episcopal Church, and the association was welcomed to the city by William Hale Thompson, mayor of Chicago. L. A. North, superintendent of shops of the Illinois Central, at Burnside, responded to the mayor.

PRESIDENT SCOTT'S ADDRESS

The increased size of locomotives has in some respects put to a test the capacity of the general shop and roundhouse foremen, who, in order to meet the increased demands on their intelligence, are becoming affiliated with various mechanical organizations for the purpose of gaining knowledge to meet the new conditions in the most intelligent manner possible. As to the future of this organization, I am very much in favor of the consolidation plan as briefly outlined by President Gaines in his opening address at the last convention of the American Railway Master Mechanics' Association. I believe it means that the minor associations will obtain more helpful recognition from the larger associations, which in turn will lead to a better understanding and co-operation along the lines of economical standardization of locomotive parts and appliances. I am in favor of this organization delegating the chairman of the executive committee to advise and act with other executive chairmen of all mechanical organizations for the purpose of exchanging views on this subject, bringing to the next convention a report of his findings. However, I would not favor any plan being adopted that would take away from the minor organizations their individuality.

VALVES AND VALVE GEARING

The most important problem that confronts the motive power department at the present time is to bring about economy in locomotive operation. The valve motion is next in importance to the boiler in determining the efficiency of the locomotive as a whole; hence the vital importance of a proper design, construction, and maintenance of this feature. Poor steam distribution results in loss of power in the engine, excessive fuel consumption, and an increased cost of repairs.

The value of indicator diagrams in the study of valve events cannot be overestimated. The indicator card shows plainly whether or not the engine has the proper valve setting. The idea that as long as an engine sounds square, the valve motion is all right is a fallacy. A number of new engines were received on a certain road that were extravagant on fuel, the main pins ran hot, and the engines were logy in movement, and would not handle their rated tonnage. The indicator was applied, and the diagrams revealed a condition showing excessive cylinder clearance. It was found that the pistons were only 5 in. thick instead of 6 in., as specified.

There is some doubt as to whether the piston valve is really more economical in steam consumption than the slide valve, and a number of tests have been made, some showing better for one, some showing more economy for the other. It is evident that this question of economy depends greatly upon the design and maintenance of the valve, as a well designed slide valve may surpass the poorly designed piston valve, and vice versa.

One of the principal advantages of the piston valve over the slide valve is the fact that the former is fully balanced, and it is easier to manipulate the reverse lever in the cab.

Slide Valves—A slide valve when used on a very long cylinder gives undue cylinder clearance due to the increased length of ports. The chief advantage of the slide valve lies in the fact that it can relieve itself of excess compression by lifting.

The secret in getting good service from the slide valve is the careful maintenance of the balancing feature. Pressure plates are often lined too far away from the valve, with the result that the latter may vibrate up and down in the yoke. The distance between the pressure plate and the valve should not exceed 3/32 in. When the balance strip springs have too much set, the end strips have a tendency to wear grooves in the pressure plate. Probably the greatest number of engine failures on account of slide valves are due to broken valve yokes and stems. Most of these are traceable to excessive friction due to cut valve seats, faulty lubrication, or defects in the balancing feature.

Piston Valves.—The advantages of the piston valve are: Increased port area for both admission and exhaust; ports in cylinder made very straight and direct; a simpler, lighter and cheaper cylinder casting; its adaptability to any design of valve gear; with inside admission valves the steam passages are better protected from the cold and radiation, and the steam chest heads and packings relieved from high pressure; accessibility of parts; better balance which makes it easier to handle, and decreases the wear and tear on the motion work, and the relative frictional resistance of the piston valve is much less than the slide valve. The greatest disadvantage under which the piston valve labors is its inability to relieve excess pressure in the cylinder port by lifting, after the manner of the slide valve.

Tests made on the Pennsylvania Railroad showed that the piston valve could be largely standardized and that a 12-in. diameter valve was large enough for cylinders up to 27 in., in diameter, when used with superheated steam. There is undoubted advantage in a small valve from a maintenance standpoint; a small valve means a light valve, and a light valve means much reduced stress on the valve motion, especially at high speed.

The piston valve packing rings in general use are the rectangular, the L, the T, and the Z-shaped rings. The L-shaped valve ring is the most widely used of any at the present time. It has the advantage of giving a very much better port opening with less wire drawing of the steam than that obtained with the rectangular ring. On the other hand it has a greater unbalanced surface than the rectangular ring. The T-shaped ring does not possess any special advantage over the L-ring. It has a more symmetrical shape, and perhaps has a more uniform bearing against the chamber bushing. The Z-shaped ring is a modification of the L ring. It is provided, on the edge that fits against the bull ring, with a lip on the outer side projecting about 1/16 in. into a corresponding recess in the bull ring to prevent any portion of the ring dropping into the port in case it should break up. It is generally conceded that the piston valve is much easier to lubricate than the slide valve. It is mostly at high speeds and in the running cut-off that the matter of lubrication is serious. When superheated engines with piston valves are permitted to drift long distances, the troubles from poor lubrication are overcome by the use of drifting and circulating valves or drifting throttles. It is the consensus of opinion at the present time that the method in which the oil is discharged in the passageway, or in the outside steam pipe is the most satisfactory method of lubrication. On the Illinois Central three circular grooves are cut around each bull ring of the piston valve. It is said this method greatly facilitates lubrication.

The secret of success in the maintenance of piston valves is

the careful fitting of the bull rings and packing rings and the frequent reboring of valve cages so the rings will have a perfect bearing on the cage. Also the valve rod crosshead must hold the valve stem in perfect alinement with the line of bore of the chamber.

Cast iron for valve rings should be tough and close grained. It is claimed that Hunt-Spiller gun iron possesses these qualities. Many roads report having obtained excellent results from the use of this material. The latest practice in piston valve bushings is a cast iron bushing with vanadium content. The common method in applying valve rings is to use rings from 3/64 to ⅛-in. larger than the bore of the bushing, and cut out enough so that they will have between 1/32 and 1/16-in. opening when the valve is in place. The best fitting packing rings are turned to the old piston ring rule—the rings are turned from 3/32 to 3/16-in. larger than the bore, according to the size of the valve, then from 3/16 to ½-in. cut out, the ring clamped in a jig, and turned to the exact size of the cage. The standard practice card of the American Locomotive Company for a 14-in. valve requires rings 14 5/32-in., then 7/16-in. cut from these, and next closed with a 1/32-in. temporary liner, and turned to the bore of the bushing while clamped in this position. A very effective method of turning rings to the bore of the cage has been developed on the Illinois Central. The packing tubs are slotted with a slot from 3/16-in to 5/16-in. wide, depending on the diameter of the ring. The pot is then clamped together and turned to the size of the bushing. A second chucking is required to face the opposite side. Some railroad men contend that rings turned with from 3/32-in. to ⅛-in. snap come to a bearing very soon, and that the other method is an unnecessary refinement.

It seems to be the practice in most shops to machine valve rings from a pot, using an engine lathe or a boring mill. The vertical turret lathe possesses special advantages for this work, and where used has given splendid results. In a number of shops expanding chucks are used for holding valve rings while the wearing face is turned, and a rotary saw is used for the work of cutting out.

The vertical turret lathe is probably best adapted for machining bushings of the sectional type, but in some cases it may be possible to get equally good results from the boring mill. At the Schenectady Works of the American Locomotive Company, a vertical milling machine which has a special rotary feed attachment is used to machine the cored port openings in valve bushings. The bushing is held between two flanged discs, one of which is fastened to the spindle of a worm gear. The feed handle is attached to the screw which drives the worm gear. In the West Milwaukee shops of the Chicago, Milwaukee & St. Paul, a similar attachment is used in connection with a shaper.

Two general methods are used for putting in valve cages; one is to heat the chamber and push or pull the bushing in, and the other is to pull it in with a wrench by use of a threaded rod with plates and a nut. Without question a portable hydraulic ram is the most effective means yet devised.

It is the practice on a large number of roads to rebore bushings after they are in place. When piston valve bushings are rebored the valves are not interchangeable, and a standard sized packing ring and bull ring cannot be maintained. For this reason it is the practice on several roads to renew bushings instead of reboring them. When piston valves are properly taken care of the bushings should run at least 200,000 miles without reboring, provided the valves were properly fitted in the first place.

By far the greatest number of blows in piston valves are due to cut and worn packing rings, and bushings that are out of round or shouldered, but occasionally a blow will result from other causes. Blows not commonly met with are due to the following causes: Bushings loose in the valve chamber allowing steam to blow through; cracked bushings; bull rings cracked or loose between the spool and follower; sand holes in the spool or valve body, and followers loose on the valve stem. It is the practice on some roads to make a periodical examination of piston valves, in order that failures and inefficiency from this source may be avoided as far as possible.

When sectional valve bushings are used it is sometimes a difficult matter to get the valve entered in the second bushing on account of the valve dropping down between the bushings. In order to facilitate matters in this regard, the New York Central provides piston valve cylinders with a guide strip cast in the bottom of the valve chamber. In some engine houses the work of pulling valves for inspection has been greatly facilitated by the use of a simple contrivance consisting of a slide made of pipe or bar iron which is supported by the valve chamber studs on one end and by feet on the pilot beam.

The formation of carbon in the valve chamber often makes it a very difficult matter to pull out the valve. At Burnside on the Illinois Central an oxygen burner is used to burn out the carbonization in valve chambers and steam and exhaust ports.

A great deal of the trouble experienced with lame engines on some roads is due to defects in the valves themselves, and not from distorted valve gears. In order that square valve events may be obtained the valves and bridges must be of the correct dimensions to give the desired lap and exhaust clearance, and there must not be the slightest variation on the two sides of the engine.

Valve Gears.—At the present time four general designs of valve gears are used in this country. They are: The Stephenson link motion; the Walschaert valve gear; the Baker valve gear, and the Southern valve gear. The principal advantages of outside valve gears are: Accessibility for lubrication, inspection and repairs; opportunity for heavy cross bracing between the frames; motion can be made more direct, and with fewer wearing parts, and ability to hold their adjustment for a greater length of time.

The disadvantages of the outside valve gears are: Liability of damage from side swipes; rod work, changing of tires, etc., made more difficult due to the location of outside valve gears, and slight distortion of the valve events due to up and down movement of the main wheel, and with it the eccentric crank, and back end of the eccentric rod.

Aside from the matter of good steam distribution, there are a number of items that must be considered in the selection of a valve gear for different classes of service. They are: First cost; cost of maintenance and repairs; efficiency and reliability of service; ability to hold adjustment, and ease of handling in the cab.

Three of the most important features to be considered, in the design and construction of an outside valve gear are: Necessity for providing as rigid a support as possible; provisions for reducing wear to a minimum, and providing sufficient lubrication at every point.

The advantages to be derived from the use of high class materials for valve gear parts have been recognized, and at the present time the tendency is to use steel for these parts. The recent Pennsylvania engines have all motion work parts of heat-treated steel. Soft steel is used extensively for transmitting and other valve gear rods, and the jaws are usually case-hardened to give good wearing qualities. Cast steel is only adapted for certain parts, and where used should be annealed. The American Locomotive Company follows the practice of using drop forged motion work parts wherever it is possible to do so. Drop forged motion work parts have the advantage of requiring very little finish, and are strong and durable.

The outside valve gears produce a more uniform steam distribution with a lower percentage of preadmission than the Stephenson link motion. They hold their adjustment, and consequently give a better steam distribution for a greater length of time.

Some trouble has been experienced on several roads, the

eccentric crank cracking, due to the spreading action when the crank is driven on the main pin. The Pennsylvania has a design of channeled eccentric crank with the slot and binding bolt on the inside. This design overcomes the liability of cracking when spread as in the ordinary type. On this same road it is the practice to key main crank pins to the driving wheels.

Without question the method of setting valves to get best results, is to take one engine of each class, and make changes as shown by accurate indicator tests, setting the other engines of that class accordingly. However, the sound of the exhaust is usually depended upon to determine whether or not the valves are square and distributing the steam as they should. A slight variation in the cut-off, even though it is not discernible from the sound of the exhaust, greatly affects the load on the piston.

Steel tubing can be obtained in all sizes, and is especially adapted for motion work bushings, requiring very little finish. This practice is followed on a number of roads. The best practice is to grind bushings, inside and out, to a standard gage, and this method is followed by most builders.

The Stephenson gear possesses the peculiarity of being exceedingly sensitive to a close adjustment of all its parts in order that a correct action and proper distribution of the steam may be obtained. It is the most flexible of any in use and can be most readily adapted to irregularities in the running and operation of the engine. At the same time it will get out of adjustment very easily, and requires the utmost care in its design in order that it may work properly. With the link motion in actual service there are three sources of error which cause a variation in the same events for the two ends of the cylinder, and which must be compensated for in some manner. They are: The location of the eccentric rod pins back of the link arc; the angular vibration of the eccentric rods, and the angular vibration of the connecting rod. To a certain extent the latter two compensate for the first, but not entirely, and to complete the compensation the hanger stud is set back of the link arc. The object of this offset is to hang the link so that it has a rising and falling motion on the stud to counteract the difference in motion between the forward and back strokes.

In certain classes of service the variable lead given by the Stephenson link motion permits the locomotive to accelerate more rapidly and to better adjust itself to different operating conditions than is possible with the valve gears giving a constant lead. Variable lead and flexibility are the chief characteristics of the gear.

The tendency at the present time in setting valves operated with the Stephenson gear is to reduce the full gear lead, or rather to adjust the valve gear to the running cut-off and permitting the full gears to take such lead as the length of the eccentric rods will give, or to specify the lead in full gear, and sacrifice the back motion in order to get the required lead at quarter stroke.

There are a number of Walschaert valve gear designs in service which do not give the best results due to the fact that proper care has not been taken to properly proportion and locate the parts to compensate, as far as possible, for the irregularities inherent in all valve gears. The most important items to be considered in the design of the Walschaert gear are: The location and proportions of the link; the location of the reverse shaft; the location and throw of the eccentric crank, and the necessity for a true deduction of the crosshead travel to that of the valve stem.

The Walschaert gear may be designed to give a variable lead. This is suitable only for passenger and fast freight locomotives; and not for slow freight and switching locomotives. It is necessary to make the eccentric crank of a different length than for constant lead. No change in the method of proportioning the combination lever is necessary except that its length must be such as to give the lead required when the radius bar is in the center of the link.

In order to eliminate as far as possible the necessity for setting the Walschaert valve gear, a system has been perfected, by the Baltimore & Ohio, whereby gages are used.

The link is by far the most troublesome part of the Walschaert gear. It is the largest item in the cost of maintenance of this gear. Many different methods are used to take up the wear, but the work can be done most efficiently by the radius grinder.

Most of the engine failures from the Walschaert gear are caused by the carelessness of workmen. Many failures are due to neglect; nuts are not properly tightened on the motion work pins, and cotter keys are not put in place.

Baker Gear.—The Baker gear differs from all other locomotive valve gears in that it entirely eliminates the link, obtaining the reverse and cut-off movement by means of a reverse yoke and radius bar. It resembles the Walschaert gear in many respects, and offers all of the advantages claimed for the latter, but with important additional advantages, which are: The oscillating link, is eliminated; the total weight of the reciprocating parts of the Baker gear is considerably less than that of the Walschaert gear, and the gear is standardized so that one design is applicable to all engines regardless of the size or class.

The Baker gear gives a constant lead with a variable preadmission. In full gear there is practically no preadmission and the indicator cards show a low compression line. It is claimed that the Baker gear gives the longest release for a given cut-off and lap condition of any valve gear in use. On account of its entire lack of sliding connections, the fact that each bearing is essentially of the pin and bushing type, and because of its extremely light weight and rigid construction, this gear requires very little maintenance while in service.

Southern Valve Gear.—The Southern locomotive valve gear is the latest development in outside valve gears and embodies certain principles not heretofore used in outside valve gear construction. The advantages claimed for this gear are: It has few parts, thus tending to reduce the reciprocating weights; it has only eight possible points of wear or a total of sixteen points of wear per locomotive; transforming from a rotary motion to a reciprocating motion is accomplished by direct movements, and on straight lines, doing away with strains and distortions; the stationary link, which does away with what is generally called the slip in the link block; the crosshead connection has been eliminated altogether.

Young Valve Gear.—An entirely new design of radial outside valve gear has recently been developed by O. W. Young. It was designed with the object of taking care of the large cylinder volumes now being used, and hence a gear of greater capacity than those now in use. The Young gear has capacity for greater travel without excessive angularities. This permits more lap, lead, and exhaust clearance, and in consequence wider openings without change in the time of the events. Preadmission, release and closure will take place at the same period of the stroke, but the added area will facilitate the rapid flow of larger volumes.

The report is signed by:—Walter Smith, (C. & N. W.), chairman; C. A. Barnes (C. & W. I.); G. W. Keller (N. & W.); T. M. Dewar (C. & O.); B. F. Harris (So. Pac.); J. Miller (Ill. Cent.); N. J. Shasberger (N. Y. C. West); C. D. Rafferty (K. & N.), and F. Anderson (C. St. P. M. & O.).

DISCUSSION

The greater part of the first two sessions was devoted to the discussion of this report, which covered 65 pages in the advance sheets. One member strongly advocated the Stephenson valve gear for switch engines because of the variable lead which assists in starting. While the piston valve is accepted as the best all-around valve and is especially desirable on superheater locomotives, some roads have found that the slide valve could be made to work satisfactorily on these locomotives. The Delaware, Lackawanna & Western is using these valves with a special system of lubrication. There is quite a difference of opinion re-

garding the use of superheater valve oil on superheater locomotives, some claiming that as good results could be obtained with Perfection oil, which gives less trouble in the gumming up of the ports.

Some members reported favorable results with common gray iron piston valve bearings, while others believed that special metals give enough better service to warrant the additional expense. W. F. Lauer, of the Illinois Central, reported that on a test run with a superheater passenger locomotive fitted with Hunt-Spiller bushings and rings, 266,000 miles had been made using one pint of valve oil for every 65 miles. It was clearly shown that from the standpoint of economical operation it is very necessary to keep the valves in first-class condition. There was, however, quite a difference of opinion concerning the maintenance of piston valves. Some roads advocate boring the valve bushings after they have been applied, in order to insure that they are perfectly round. It is generally the practice to rebore the valve chamber when it is a scant 1/32-in. out of round. However, some roads never rebore the piston valve bushings, believing it better to remove the bushing and apply a new one, thus keeping the diameter standard, and requiring a less number of packing rings to be carried in stock. It was believed by one member that if the valves are kept properly lubricated they will not have to be rebored in three or four years. Several roads inspect the valves for blows every 30 days, some making these inspections every 60 days, while others make no inspection at all. Those roads operating under the assigned engine system believe that regular inspections of the locomotives operated in this way are unnecessary.

The Pennsylvania makes a practice of marking the date the packing rings are applied to the valves and cylinders, in order that their service may be properly followed. Some members believed that much better results would be obtained from packing rings if, when they were made, they were clamped together after they were split, and turned to the proper size. It is claimed this will provide a more even bearing on the piston valve bushings.

Where the balanced slide valve is used it was believed to be the better practice to use springs only under the two long strips suspending the side strips from them. This will reduce the wear on the top bearing plates. One road has found that the bronze valve seats in superheater slide valve engines do not give desired results. Where graphite is used care should be taken that too much is not fed to the cylinder at one time.

The use of the piston valve accessories, such as vacuum valves, has been quite generally done away with. Good service records were reported for both the Baker and the Walschaert valve gears. Special stress was placed on the necessity for proper and careful design of valve gears. One of the most important claims made for the Baker gear is the standardization of parts for all locomotives.

RODS, TIRES AND WHEELS

Rods.—One member of the committee was strongly in favor of the rectangular rod as against the I-beam rod, saying that the rectangular rod is much less subject to fracture and that it is about 20 per cent. cheaper to make. The material in the rod should be mild steel, without welds. The forked end rod was recommended, as there is less work in maintaining this style of rod, as but one bolt is required against three for the strapped end, and there is also about one-half as much surface to be trued up when the rods are undergoing general repairs. For the crank pin bearings in the side rods on heavy engines the split brass and straps was recommended for the reason that it is less expensive to keep them in proper condition. Where the strap is used a steel liner should be used between the key and the brass in order to insure a broad bearing surface on the back of the brass.

One road is experimenting with cast iron crank pin bushings with babbitt blocks dovetailed in them on some large freight engines. One set has been running five and one-half months and so far shows but little wear. While the cost of making these bushings is more than for making the brass bushings the difference in the cost of metal materially offsets this difference. One road has tried both brass and steel bushings for knuckle joints, and found the steel to be more efficient. It was pretty generally conceded that all rods should be annealed at least every one or two years. When the rods are removed they should be given a thorough cleaning and a very careful inspection to detect any flaws. Among the many causes of broken rods and poor service are the rods being out of tram, the engine being out of tram, rod collars binding on the rod brasses, the pins worn out of round, undetected flaws in the straps or rods, the engine out of quarter and the engine not properly counterbalanced.

When applying the bolts to strap end rods care must be taken to have them fit properly in the strap at the top and bottom. To accomplish this the middle of the bolt may be turned about 1/32 in. under to insure a good bearing fit in the strap. On strap end rods one road is changing from the key to the wedge type for safety and durability. It is found they give better service and they eliminate a lot of extra work. One road is using the electric welding process to build up the worn parts in the metal end of the rods and for welding small cracks in the jaws and rods to prevent them from getting larger. The knuckle joint pin should be carefully inspected at all times to prevent the possibility of the knuckle joint pin nut becoming loose, allowing the pin to work out and catch on the driving wheel. Care should also be taken to keep the side rod collars from becoming loose for the same reason. It was recommended that cotter keys be placed in all main rod keys in conjunction with the two set screws, to provide additional safety.

Tires.—Locomotive tires should not be too soft nor too hard. Those that give a wear of 1/32 in. a month are considered satisfactory. It is recommended by one member that a lip be placed on all tires to facilitate the setting, and also to prevent the tires from creeping in when they become loose. The rim of the driving wheel centers should be 5 in. wide to give a proper bearing surface on the tire. One member recommends that the wear of the tire in the center be not allowed to exceed ¼-in., and that flat spots should be limited to 1/16 in. in passenger service and ⅛ in. in freight. For a minimum thickness of tire the Soo line uses the following: For 44-in. to 50-in. inside diameter tires the minimum thickness should be 1¾ in., for 56-in. tires, 2 in., for 62 to 68-in. tires, 2⅛ in., for 72-in. and over, 2¼ in. When the tires get thin the driver brakes should be watched to see that they do not drag.

In the application of tires various methods were suggested. Some use commercial gas, others gasolene, natural gas, fuel oil and wood fires. One road reported that with a wood fire eight new tires were applied in 42 minutes. A shrinkage of 1/80 in. to a foot in diameter was considered to be good practice. Retaining rings were recommended for passenger engines, and the use of shims was believed to be bad practice on new tires. They should be bored to fit the wheel center. One road removes old and worn out tires by cutting them with the oxy-acetylene flame and wedging them apart so that they may be easily taken from the wheel centers.

Cut flanges are caused by the guiding wheels being out of square, the wheels out of tram, the lateral motion not properly distributed, the engine leaning to one side and the engine not being level on the track. Where other means for reducing flange wear are not obtainable, some roads have found that steam led from the steam end of the air pump through ¼-in. pipe and discharging through a 1/32-in. hole in the end of this pipe serves to lubricate the flange very nicely.

Driving Axles.—Steel was believed by the committee to be the best material of which to make driving axles. One road has run successfully axles ½ in. below their original size, while

another road will remove the axles when they are ¼ in. below size. When axles are in for general shopping they may be found perfectly round, but eccentric. It was therefore recommended that they be turned at each general shopping. A careful inspection should be made for flaws near the hubs, and the axles that have given trouble from hot boxes should be given careful inspection. It was generally believed better to lay out the key way for the eccentrics on Stephenson gear engines before the engine is wheeled, this saving considerable labor.

Crank Pins.—Where shops are equipped with quartering machines it is considered good practice to test all pins for quarter and stroke at every shopping. Main pins having the main rod brass bearings outside of the side rods, are changed every ten years on the Soo line, as it is found that they break at about that time. On other roads they are changed oftener. One road removes all crank pins that show in excess of 1/16 in. wear on the bearing surface, and makes new pins from old driving axles. The washer on the end of the crank pin should be very substantial and strongly attached to the pin. It should not be attempted to file a pin round as it is very liable to become eccentric. One road adopts the practice of stamping the date and the shop at which the crank pins are applied for the information of the man who next handles the engine in general repairs.

The report is signed by A. A. Masters, chairman; W. G. Reyer (N. C. & St. L.); M. J. Hayes (C. H. & D.); A. D. Clark (C. G. W.); A. B. Corbett (M. K. & T.); W. T. Gale (C. & N. W.); W. F. Lauer (I. C.), and A. F. Taylor (M., St. P. & S. S. M.).

DISCUSSION

Several members reported that they were discarding channel rods and applying the rectangular or slab rods on account of the channel rods breaking. On heavy engines a number of the members recommended strap end rods on the middle connection. Where bushings are used, care should be taken that they are not pressed in at too great a pressure, as it is believed that the stress thus imposed destroys the life of the brass. The Lehigh & New England has increased the bearing of the bushing in the rod with very good success, and anchors the bushing at the top and bottom with a plug. Special metal, such as gun metal, has been used instead of brass for rod bushings with very good success, if it is properly lubricated. Some roads have even used gray iron.

Several members spoke strongly in favor of the automatic flange oiler, but it was pointed out that the enginemen should be carefully instructed to handle it properly. Some roads require the engine inspector to start the oilers before the engines leave the terminal.

Several methods were reported for heating the tires, the cheapest being that where wood was used as a fuel the wood being scrap material. The Soo line applies tires by this method at a cost of 16 cents a piece. Where shimming the tires was found necessary it was believed to be the best practice to use continuous shims. Several members reported that they were using cast iron for hub liners, while one uses no hub liners until the wheels become sufficiently worn, then bronze was used. This road uses oil cellars in the driving box.

SHOP EFFICIENCY

The greatest factor in effecting and maintaining shop efficiency is competent supervision.

Competent supervision, insuring competent workmen, make it possible for an old shop, with less modern tools and facilities, to not only equal, but exceed the output of the modern shop with the latest improved facilities, which, however, is poorly supervised. The foreman and the gang foreman who is in direct touch with the individual workman is the man who is largely responsible for efficiency and his qualifications necessarily must be many. A combination of executive and mechanical ability is to be desired, and if he lacks in either, it is better that his executive ability be the greater.

He must be able to gain and hold the respect of his men by quiet insistence on the observance of the rules in effect. He must be quick to recognize men's individual capabilities and assign them work for which they are best qualified. He must be able to systematize and outline his work so that there are no lost movements or delays. He should be diplomatic in his dealings with department foremen, insuring harmony, though insistent upon work required from them being handled promptly. He should enthuse his men to such an extent that they take a pride in equaling or excelling an exceptionally good performance made a matter of record by another department or shop. He should be active and energetic as an example to his men, dealing fairly with them, never, under any circumstances, allowing personal feelings or prejudice to influence his treatment of them.

Close supervision is conceded to be profitable, and no foreman should have under him more men than he can keep in touch with intelligently. He should be able not only to know what each man is doing, but how he is doing it.

Weekly foremen's meetings, held in some suitable office, and presided over by the shop superintendent or general foreman, are essential to efficiency. All department foremen and a representative from the store department should attend these meetings. Engines undergoing repairs should be considered, each in their turn (it being assumed that a schedule time is set for all classes of repairs). Every department being represented insures that the dates given for completion of repairs will be nearly accurate, and a thorough understanding of the conditions is reached by all concerned. Shop problems and difficulties should be thoroughly threshed out and differences between various departments adjusted.

Shop Schedules.—No shop can be efficient unless there is a fixed time set for the completion of repairs to the engines. There is no real need of an elaborate schedule which covers the time each separate part of an engine must be finished, but there is an absolute need of a schedule which allows a certain number of hours for each class of repairs handled, consistent with facilities the shop affords.

The Chicago & North Western has had a schedule in force for a great many years past, and its worth was proved very shortly after its inauguration. Forms termed "In and Out Sheet," spaced to show engines on pits in each gang under the heads Gang 1, 2, 3, 4, 5, etc., are made out each week and show all engines in the shop, with their schedule dates. At the foremen's meeting, if it is found that the repairs cannot be finished on the schedule date, a later date is set and is shown on the form under the heading "Engines delayed." Several large blackboards are placed in conspicuous parts of the shop, and engine numbers and dates out of the shop are shown on these boards.

In addition to these a number of slips are printed each week after the dates have been confirmed or changed at the Foremen's meeting. The slips are distributed to all men on machines who do a special line of work, and to the various special men who work on the erecting floor.

The men post these slips on their cupboards or in any place where it can be readily seen by their foreman, and as they complete their work for an engine, they draw a line through its number on the slip, and the foreman in passing can see at a glance whether or not a man is within the time allowance set for the completion of his particular work.

If, by reason of financial depression, it is necessary to operate a 20-pit shop, for instance, with only enough men to properly handle ten engines, put but ten engines in the shop and get them out as quickly as possible, as even with the closet kind of supervision and checking of labor and material charges the cost of repairs on twenty engines handled with a ten-engine force will

be above the usual cost of repairs, when engines are repaired in their usual time. There are a number of logical reasons for this, but we will mention only two: The first and principal reason in a shop which has been working full force under a satisfactory schedule, is, of course, the changes which must unquestionably be made in the schedule time, thus causing disorganization of the systems, and making for confusion and its attendant delay.

The second reason is the noticeable relaxation of efforts of the working forces who, under a short schedule, were keyed to a much higher pitch, and the need of haste to get work completed on time kept men energetic and active, but the lengthening of the schedule has seemingly indicated to them that the need of haste has been obviated and that they now have lots of time, and it is a difficult matter to keep them from taking it. Schedule time as short as consistent with conditions, makes for efficiency.

Facilities.—Modern facilities make for efficiency and where an improved tool or appliance will show a consistent increased output sufficient to pay a good rate of interest on the investment, it should be bought and installed. An inferior tool, forced on a supervisor, which will not equal the output of the one he specified, is discouraging and does not tend to increase shop efficiency.

Whatever the equipment, it can and should be worked to its limit. Machines should be worked to their safe capacity as to speed and feed. The capacity is easily determined by crowding on the feed.

Machines should be so located that there are no retrograde movements necessary on work which several machines must care for, the shortest movements possible should be made from the time the work is delivered to the initial machine until its completion at the last machine.

High speed drills are as essential as high speed tools. Jigs and gages for drilling and laying out cost money to make, but this cost is negligible when results are considered and you must have them to be efficient. Devices which expedite the movement of any work should be made and put in use.

A sufficient supply of small tools in good condition must be available, such as taps, dies, reamers, cutters, wrenches, files, etc. The cost of small taps and files is so small that it is possible for a machinist working with either a tap or file in unserviceable condition to consume enough extra time in three hours' work to pay for a brand new tap or file.

Manufacturing Department.—Undoubtedly all roads have recognized the large measure of efficiency obtained through the manufacturing department, in which all parts of locomotives are made or finished, and delivered to the store department for stock, and in turn distributed to all smaller points on the system. This department necessarily has the most modern machines and facilities. The men employed are specialists. Jigs, templates, formers, arbors and clamps should be, and usually are, found in great abundance in this department. The store department can reduce the efficiency of the manufacturing department by not ordering a large enough quantity of certain materials.

Tool Room.—In a large shop where mechanics get their own tools on checks from the tool room, the delays of a minute multiplied by the number of times they occur in a day and by the number of men affected, run into hours, which in turn mean dollars. Therefore, energetic, quick moving and thinking men, who know the condition of all tools in their charge, and who do not leave a defective tool where it may get in service, are necessary. The average railroad tool room absolutely cannot expect to compete with the manufacturer as regards the making of small tools and dies. We should never make or repair anything which we can buy equally as good for less cost, except in an emergency case.

Apprentices.—An apprentice makes for efficiency in proportion to the amount of interest he shows and the amount of interest that is taken in him. Select boys with as good an education as possible and who have a real desire to master the trade they wish to follow. Give him every opportunity to thoroughly learn his trade. Apprentice schools increase the efficiency in some shops—why not schools in all shops? Employ all apprentices on probation, and if it is seen at the expiration of six months, after an earnest and conscientious effort to make him qualify, that he is not adapted to the trade, dismiss him, as he may make a splendid success in some other line of business, and you will have done him an injustice if you allow him to serve his time and then be obliged to put up with his incompetency or dismiss him, with four years of his time wasted.

Shop Demonstrator.—A thoroughly competent demonstrator in a shop of any size is an absolute necessity. It is through his efforts largely that maximum capacity of machine output is obtained. He is invaluable because of his intimate knowledge of machines, enabling him to break in a new machine or a new operator on any machine which is at all complex. His work is not confined to machines, but to any proposition which needs close checking to insure results. It takes an intelligent and absolutely fair-minded man to qualify for this position, and qualifying, he certainly does much to insure efficiency.

Store Department.—The store department can increase the efficiency by keeping a stock consistent with the mechanical department's needs and the prompt shipment of necessary material to the unfortunately located foreman of shops at an outside point where only stock common to ordinary requirements is carried. When it is considered that, as stated by G. S. Goodwin, in a paper read before the Western Railway Club of Chicago, last February, the average value of a locomotive's services through the United States was $44 a day, it is problematical whether the cause of efficiency is best served by the store department keeping material so low that at any time it makes for an engine delay. The question should be given the most careful analysis.

Storekeepers and shop supervisors must keep in close touch. Advance notice of engines to be shopped and the probable material which will be needed given to the storekeeper enables him to make special requisitions for this material, and it is usually available when the engine is finally shopped.

Shop Appearance.—Shops should be roomy and well ventilated; windows so designed and lighting systems so planned that there are no dark spaces and glare of sun or lights so modified that the eyes of the employes are not subjected to any undue strain; lockers and toilet rooms sufficient for the convenience of all employes should be installed and maintained in an absolutely sanitary condition. The shops should be kept clean and tidy. Material and engine parts should be piled and never be allowed to be thrown promiscuously around the floor. The grounds about the shops should be kept as neat as the interior of the shops.

Timekeeping and Checking.—A little less than two years ago an improved system of checking the work performed by individual men was installed in the Frisco shops. Certain mechanics were selected as checkers. The duty of these men is to be constantly about the shop during working hours, recording in some detail the operations performed by the various men under their care, and setting down the time at which such jobs are begun and finished. It has been found that one checker will handle from 60 to 75 workmen. The actual working time saved by not requiring the individual men to make out their distribution cards has more than paid the wages of the checkers employed. In addition to this accurate records of the work performed and of the time consumed are obtained.

In connection with this system of checking, all the clerical work of timekeeping and labor distribution has been concentrated in the office of superintendent of motive power. This has reduced the total cost of keeping time and distribution by approximately one half.

Routing.—Each engine, as it arrives at the shop for repairs, is thoroughly inspected and the work to be performed recorded. The routing man, who is, in fact, assistant to the general foreman, makes out the necessary forms covering the engine, and with the advice of the general foreman determines the number of days which shall be allowed for the completion of repairs.

The routing man then fills in the detail dates for the completion of each of the individual operations. Cards are then prepared for each department and gang foreman.

By this scheme the general foreman is relieved in a large measure from following up the smaller details of work on the engine; the routing man makes numerous daily trips through the shop checking up his sheets to ascertain what work is falling behind the schedule. A delay report placed on the general foreman's desk each morning calls his attention to the departments or gangs which are falling behind. The individual foremen are also relieved of tracing their work through other departments, and the gang and department foremen are able to devote their entire time to the supervision of work under their charge.

Standardization of Tools.—The Frisco employs a supervisor of tools, who is a specialist in tool design and operation. By a careful study of conditions and by an accurate check of the equipment in use this man has been able to materially reduce the cost of tool maintenance, and at the same time to increase its quality. All the cutting tools for the system are manufactured in a central shop, thus insuring perfection of design and quality and the lowest cost of manufacturing. No tool steel whatever is furnished to outside points, which prevents the misuse of expensive high speed steel, by allowing it to be worked up by inexperienced mechanics.

When sufficient pit room is available and the time locomotives are in the shop is of no great importance, a scheduling system could be worked out that would give fair results. But there are not many railroads that have more shop capacity than is required when business is good. Consequently, locomotives should be repaired and gotten out of the shop with the least possible delay.

A good system for obtaining maximum efficiency from a locomotive repair shop provides for a hurry-up meeting each morning. At this meeting the erecting shop foreman will inform the general foreman of the exact status of repairs. He will also give him a list of material that may be needed to complete the repairs. The other foremen, being on hand, can answer for any material that belongs to their department. The entire subject of output and material can be handled in from fifteen minutes to half an hour, and many subjects that may interest two or three or more departments can be disposed of at once. The general foreman knows at all times the state of repairs of each locomotive.

The report is signed by: Geo. H. Logan (C. & N. W.), chairman; J. M. Kerwin (C., R. I. & P.); J. C. Newmarch (N. Y. C.); C. M. Newman (A. C. L.); J. Miller (I. C.); E. E. Greist (Penn. Lines); F. A. Byers (St. L. & S. F.); Wm. Smith (P. & L. E.), and W. T. Abbington (C., R. I. & P.).

DISCUSSION

The discussion on this subject brought out the point that the general foreman should deal with the subordinate foreman direct, rather than go beyond them to the men. Most members believed that a schedule of the locomotive parts through the shop was desirable. Some roads go into more detail than others in this matter. On the St. Louis & San Francisco, at Springfield, Mo., a man is assigned to the routing of the material through the shop, and acts as an assistant to the general foreman. Another man devotes his whole time to checking up material, making shortage reports every day, and keeping after the store department for the material needed. The routing man also makes a daily report and red marks the work that is behind. On the Santa Fe there is a material man who works in conjunction with the shop and store department, and whose duty it is to report shortages and handle scrap and second-hand material.

On the Delaware, Lackawanna & Western there is a special committee appointed to inspect and pass on new devices or inventions presented by the employes, and if these devices are accepted for use the employes are paid in a lump sum. Other roads obtain the patent rights for the men, holding the restriction to use the devices on their own roads without the payment of royalty.

ROUNDHOUSE EFFICIENCY

The roundhouse is the conecting link between the mechanical and transportation department of a railroad. A well equipped roundhouse will do much towards strengthening this link, and it is time that more attention be paid to its construction and equipment, so that it may be brought up to the highest state of efficiency. Too much of the details of the construction of roundhouses is in the hands of the maintenance of way department, and too little in the hands of the man who is on the ground, who has to furnish the power for moving trains, and who knows more than anyyone else of what is required for the highest state of efficiency. To the roundhouse foreman belongs the responsibility for engine delays, engine failures, engine mileage, cost of dispatching, etc., and therefore his ideas and recommendations should receive the first consideration. Good light, heat and ventilation are important for facilitating roundhouse repairs, for in order to get good results from the employes conditions should be equal to those of the repair shop. Lockers and adequate toilet facilities should also be provided in order to have conditions the best.

Equipment.—Drop pits for driving wheels, engine and tender wheels should be in all roundhouses where running repairs to any extent are required. An engine may be kept out of the repair shop indefinitely by dropping the driving wheels for repairs to driving boxes, turning tires, etc. Overhead cranes or trolleys should be arranged for removing dome caps, front end doors, bumper beams, etc. Washing out systems effect a great saving as well as protecting the boiler against leaking tubes, and all roundhouses should have hot water, and plenty of it, for washing and filling boilers. Storage tanks, or sumps, should be made large enough to take care of all the water that is blown from the boilers and then used for washing out, reclaiming all of the water by filtration.

There are instances of roundhouses equipped entirely with old tools discarded by the repair shop. This is a short sighted policy. The tools for the roundhouse should be the very best, especially where it is isolated from the repair shop, and it would seem that the repair shop should take the old tools rather than the roundhouse, because the repair shop is in a better position to make repairs to them than the roundhouse.

Roundhouse piping is a subject for consideration. It would seem that the only proper and safe way to install the piping is in conduits of sufficient size to hold all the pipes and easy of access should repairs be necessary. No sewer pipe leading from the roundhouse should be less than 10-in. in diameter and preferably 12-in. Engine house pits, especially drop pits, not properly drained, give off a disagreeable and unhealthy odor.

Roundhouse tracks are also a subject for careful consideration. There should be two inbound tracks, with an emergency run around track, and two outbound tracks. The inbound tracks should be of sufficient length to admit of a water crane a reasonable distance from the entrance so that engines coming in from the road leaking and having low water in the tender can be given water; otherwise with engines ahead, they would die before getting into the house, causing delay. There should be about 350 ft. between the water crane and the coal chute, so that after taking water the engines may move ahead to wait their turn for coaling. There should be at least 600 ft. between

the coal chute and turn table to allow for engines standing after taking coal.

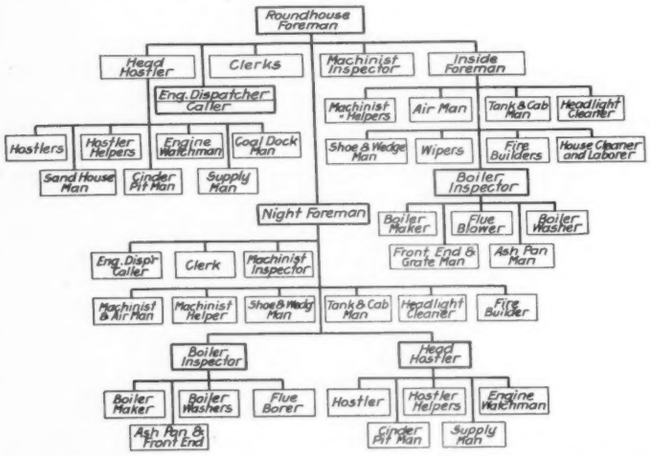
It is difficult to keep steady labor on the cinder pit at the average roundhouse, and for that reason mechanical loaders are being constructed. Damage to cars by fire from hot cinders is a matter to consider, and for that reason pits are being constructed so that the cinders can be dumped from the engine into water. The Chicago & Western Indiana loads cinders with clam shells, the cinder pits containing water to the depth of seven feet. The cinders are loaded into cars at a cost of about 12 cents per car. These cinders are sold to the track elevation department for $3 per car.

Water cranes should be located, one at the entrance of the inbound tracks, one on the inbound tracks between the cinder pit and turn table, and one on the outbound tracks.

The office and storehouse should be combined in one building conveniently close to a track for loading and unloading purposes and should be made fireproof.

Cleaning engines, on a number of roads, is being discontinued on account of the expense. This would not appear to be a good policy for the reason that the defects are liable to be covered up and may not be detected by the engine inspectors. There are several mechanical devices for cleaning engines, which bring the cost down so much lower than the hand cleaning, that it does not seem that a railroad can afford to entirely dispense with cleaning.

A very material increase of engine mileage can be obtained by the roundhouse foreman keeping up the lost motion in the valve gear, keeping driving box wedges in good shape, watching the tread wear, renewing side rod bushings and knuckle pins whenever necessary and in numerous other ways keeping the engine in good condition.



Organization for an Engine House Turning 1,000 Engines Per Month

Engine failures are subjects for criticism from the president down to the foreman. The traveling public are very critical in their opinions of railway management and do not hesitate to publicly denounce a railway company who has a failure causing delay to a passenger train. Competing lines often lose passengers on account of a failure that could have been avoided by more careful attention at the roundhouse; therefore it is very important that failures be kept down to the minimum. Competent men should be selected for air brake and engine inspectors. They should be men who can appreciate what it means to have an engine failure. Perfect organization in a roundhouse is the cure for engine failures.

The Interstate Commerce Commission requirements should not be lost sight of. The rules governing safety appliances and boiler inspection should be observed to the letter. Co-operation with the interstate inspectors will tend to make the relations much more pleasant, and if the railroads show a disposition to do all that is fair, it is not the intention of the inspectors to cause any hardships. Without a competent man as roundhouse foreman, the best of roundhouse equipment counts for naught. We find that in the majority of cases the machinists, etc., working under the roundhouse foreman's supervision are receiving the equivalent, if not more, compensation for their work than he, and they are not willing to accept his position, which carries with it the responsibility which he is forced to assume. The consequences are that some time in the future the roundhouse foreman will not be a competent man. He gives up most of his time to his work, but notwithstanding this, the instances in which he receives even words of appreciation are extraordinarily rare, and it appears that the time is opportune to begin at once to give him his just dues.

Efficiency.—Roundhouse efficiency can be practiced most successfully when the work can be specialized and each operation on an engine can be assigned to some workman who is competent to handle it in every detail. One of the most important duties is to secure all information the enginemen have to offer as to the condition of their engines. Roundhouse efficiency is developed from the organization maintained and by having facilities and tools necessary to do the work the quickest and in the most economical method. An organization chart for a roundhouse which turns 1,000 engines per month and handles all light repairs for a division of 250 miles is shown in the accompanying illustration.

A properly designed work order board located at a central point in the roundhouse where all employes can conveniently mark it when their work on an engine is completed, will be of great assistance to the organization.

The report is signed by: N. B. Whitsel (C. & W. I.), chairman; H. W. Ensign (C. G. W.); Chas. Snyder (A., T. & S. F.); E. J. Buckbee (C., C., C. & St. L.); W. S. Whitford (C. & N. W.); S. J. Harper (Y. & M. V.); W. B. Middleton (A. C. I.), and F. R. Butler (C. & O.).

DISCUSSION

Those roads that are equipped with electric cranes in the roundhouse are very strongly in favor of them, and believe that they are indispensable. Some roads use jib cranes at the posts between the pits. A number of roads also use portable lathes, some having enough work to keep a regular machinist busy on those lathes. One road reported a very satisfactory arrangement with the drainage from the roundhouses. They provide settling boxes in the sewer line to catch the waste and sediment. These boxes are cleaned every week at a nominal cost.

Several methods were mentioned for firing up locomotives. The Illinois Central, at Memphis, fires up with scrap wood and waste. Coal is first put in the firebox all around the edges, leaving a bare space in the middle. The wood and scrap waste is placed in the middle and ignited. It is claimed that this gives very little smoke. The Nashville, Chattanooga & St. Louis puts the coal in the firebox and ignites from underneath the grate with an oil burner run in through the hoppers in the ashpan; this also has proved satisfactory. The Chicago & North Western uses shavings from the planing mill. These shavings are saturated with oil and placed upon a screen to drain. Underneath this screen there are steam pipes which dry the shavings, making them easier to handle and not using as much oil.

Those roads that are cleaning their engines by washing with a mixture of oil and water under pressure find that the work is done very satisfactorily. The Delaware, Lackawanna & Western can clean a large Mikado engine by this process for not more than 30 cents, in about 15 minutes. A mixture of 75 gal. of water to 1 gal. of oil is used with a pressure of 90 lb., the pressure being taken from the air line in the shop yards. In summer cold water is used, and in winter and late fall, hot water. This method of cleaning not only gives the locomotive a very neat appearance and does the work economically, but it

keeps all the parts clean and free from grease, which permits more careful inspection. One road employing this method uses no special clothing for the cleaners, and the men keep much cleaner than when they cleaned the engines by the old process.

OXY-ACETYLENE WELDING

F. H. Byers (St. L. & S. F.)—The oxy-acetylene process of welding and cutting metals has during the past few years been adopted by many of the principal railroads. It is doubtful, however, whether any of the present installments are of as great capacity as will eventually prove necessary to handle the volume of work which can be most efficiently performed by this process. As far as is known, the largest single oxy-acetylene installation is that at the Springfield shop of the St. Louis & San Francisco. This plant, in addition to the ten others on the Frisco system, was furnished and installed by the Oxweld Railroad Service Company. The oxygen generators are of the duplex type and 1,000 cu. ft. capacity. The oxygen used is purchased from the Linde Air Products Company, being delivered to the road in 100 and 250 cu. ft. cylinders. These are connected to a duplex manifold which makes it possible to remove and replace cylinders without cutting off the gas supply to the shop. In all of the Frisco plants the oxygen and acetylene gases are piped throughout the shop, stations being placed at convenient intervals to serve the various departments.

The only trouble which has ever been experienced with oxy-acetylene welds has been due to the inefficiency or inexperience of the operators. On the Frisco welders are selected from the best journeymen of the various trades. No handy-men or apprentices are used on any class of work whatever. The mechanics who are selected are given a four months' course of training under an expert. By this system a corps of more than seventy expert welders has been trained on the Frisco system, and the work which is being turned out of the shops is of first quality. The Frisco, with first-class boilermakers as burner operators, is handling all classes of boiler work with unvarying success. When a firebox is to be renewed complete it is cut in sections and the staybolts and radial stays are burned off; the bolt heads remaining in the wrapper sheets are then burned out. By this process an entire box can be removed by two operators in less than 20 hours. It is the present practice to weld in all part sheets, whole sheets and seams of complete boxes. This method is more economical than riveting as to initial cost, and also represents a great saving in subsequent repairs required at roundhouses. The cutting torch is also used by the boilermakers for cutting holes as required in the firebox sheets, the boiler shell or the front end.

During the past two years all broken frames have been welded by the oxy-acetylene process, which has proven itself not only cheaper, but more satisfactory than any method previously used. There have been no failures on frame welds when competent operators, usually blacksmiths, were used.

This process has no limitations as to classes of metal; brass, cast, malleable and wrought iron or steel being welded with equal facility.

The principal use of the oxy-acetylene torch in car work, as so far developed, consists in the welding of cracked or broken bolsters, the repairing of couplers, and as an aid in steel underframe work. The cutting torch has proven exceptionally useful in cutting off rivets in steel underframes; this work being accomplished much more quickly and at a less cost than with the air hammer.

Not the least important field to which the oxy-acetylene process has been applied is in the expedient and economical repairing of shop machines and tools and work equipment. Where ordinarily it would be necessary to order a new part from the factory, or at great expense forge out and machine a new part, it is now possible to make effective repairs in a short time, putting the machine back in service before its absence has been seriously felt. Serious delays to work in progress are often occasioned by the disablement of certain work equipment through the breakage of parts, for which no duplicates are carried in stock. The oxy-acetylene process has made possible repairs to such machines with the minimum delay.

Old fireboxes, boilers, engine tanks, car frames and other heavy units of scrap material are often unsalable, or if they can be sold at all will scarcely yield a sufficient amount to pay for their transportation. With the cutting burner such articles as these may be reduced to convenient size for loading and handling, in which form they are readily disposed of at a fair price. This class of operation yields a large unit profit on the expenditure.

I. C. Newmarch (N. Y. C. West)—The Collinwood shops, located on the Erie division of the New York Central, use both oxy-acetylene and electricity for welding. Both have their advantages. The oxy-acetylene process is used principally for boiler work in welding or cutting. All our three-quarter side sheets, three-quarter door sheets, corner patches and such work is done with the oxy-acetylene process. We have also used it in welding up broken frames in the erecting shop, and have had fairly good success in most cases.

The electric process has its disadvantages and advantages in boiler repairs, and a careful study of each job should be made before using this method in making boiler repairs. Electric welding is here to stay and no up-to-date shop should be without it, for it is of great value in welding side sheets, door sheets, corner patches, cracked mudrings, filling up worn spots on sheets, washout plug holes and welding up small cracks in sheets up to six inches long. It is also successful in the welding of tubes in fireboxes. It is at a disadvantage in welding cracks in fireboxes over 8 in. long.

In preparing sheets and cracks for welding the best of care should be taken to get good results, first by beveling both edges of the sheet or crack 45 deg. Leave them open 3/16 in., so as to get the weld through the sheet. In building up thin spots or reducing the size of holes all scale or grease should be removed, as clean sheets insure good welding. All welds should be built up from 1/16 to ⅛ in. above the sheet to strengthen the weld.

The welding of tubes, if properly done, will reduce trouble to a minimum. First apply the tube in the same manner as if no welding were being done, except that no oil should be used on the tools in working the tubes, for electric welding is unsuccessful if there is oil on the work.

Care should be taken to see that the voltage is not too high. High voltage makes it easy for the operator, but it is not good for the tubes, as the operator with the high voltage keeps the metallic pencil ½ in. to ⅝ in. from the sheet, and the metal only sticks and does not weld. A voltage of 64 volts and 125 amperes makes the operator get within 3/16 in. of the sheet, assuring a good weld.

We reclaim all kinds of pieces, such as wheel centers with broken spokes, brake heads with lugs worn off, guides that are worn on the side and main rods that are worn on the side at the front. We can make a saving of from 20 to 70 per cent; in fact, it would be impossible for us to get along without this method.

J. M. Kerwin (C. R. I. & P.)—On the Rock Island for all heavy work such as locomotive frames we use Thermit and have also welded cast steel guide yokes with Thermit with very good success. During the year 1914 there were 82 Thermit welds made on frames at the Silvis shop, and up to date none have been found broken through the Thermit weld.

For light work such as boiler and tank sheets and small broken castings we use the electric and oxy-acetylene process and have found that the electric is the best for boiler work in welding patches and cracks, but the oxy-acetylene is best for cutting. The patches should be as nearly circular as possible.

We have repaired cracks running from the door hole rivets to the mudring. These have been electrically welded, the staybolts being removed, the holes welded up and redrilled. The welding of superheater flues and cracks in the knuckles of the tube sheets has also been successfully accomplished. We have also applied door collars and saved the application of new door sheets. The following shows the cost of applying door collar complete and the cost of applying a new door sheet:

Cost of applying door collar on average engine	$ 50.13	
Cost of electric power on average engine	2.52	
Cost of electric welding sticks	3.51	
Cost of applying door collar material	12.67—	$ 68.83
Cost of new door sheet, complete	200.00	
Cost of new door sheet material	44.00—	244.00

Total saving, $175.17.

In the machine shop we have used the electric welding process for filling in frames worn by spring hangers, building up stock on worn spring hangers, welding rim keys in driving wheels, cracked parts of motion work, new teeth on reverse lever and throttle quadrants. We have also welded flat spots on drivers and had very good success with it; also shelled out spots on cast steel wheels. With the acetylene process we have welded ports in valve seats that were broken out; this was done with brass sticks and a flux. We have also welded bells and all kinds of cracks in pipes with copper and iron.

DISCUSSION

F. A. Byers (St. L. & S. F.)—We have welded frames 4½ in. by 13 in. by the oxy-acetylene process using the No. 10 nozzle. On a large frame we use four blacksmiths and preheat to a good cherry red and expand from 5/32 in. to ¼ in. Each man works 30 minutes. They weld from the inside and outside at the same time. When we weld the top rail of a double rail, before we take out the jacks or wedges used to give the proper amount of expansion we heat the bottom rail to a cherry red and have good success. If we can we reinforce the weld nearly 2 in. all the way around. We start at the bottom and weld up, placing a ½ in. piece of iron underneath to start the weld, to make it stick on the start. We have welded 177 frames and had five failures and three of those failures were on the same engine. We welded it three times. After the frame is cut it is trimmed out by a machinist. Last month the cost of welding and cutting was $1.37 an hour for labor and material. We pay 45 cents an hour for welders.

When welding a frame the welders are on the job from the time it is hot until it is finished. We carry pressures of 50 lb. in the oxygen and 3 ounces in the acetylene. We are using one-fourth in. No. 1 rolled steel for the welding material. When the weld is large it is sometimes necessary to reheat the frame. We also remove fireboxes by cutting the staybolts with the cutting torch. It takes patience to get the scale off, but after a start is made it comes easily. We take them out in sections, two rows of staybolts at a time, and one man in four eight-hour days takes the complete firebox out, crown sheet and all, a total of 32 hours. Following is a list of the work we have done:

Welding complete fireboxes.
Welding back tube and door sheets and door collars.
Welding in crown sheets complete.
Welding crown seams after burning through center of rivets and rivet holes.
Welding half side sheets and not removing mudring rivets; cutting sides above mudring, also tube and door sheets in the same way when in good shape at the mudring.
Welding three-fourth front tube sheets, not removing steam pipes.
Welding patches in fireboxes and outside casing sheets, and building up worn places in sheets, mudring corners and around washout holes.
Welding patches on top of back tube sheets.
Welding cracked bridges in tube sheets.
Welding up staybolt holes; this saves bushing holes and sometimes patching.
Welding cracked mudring corners on either side, top or bottom.
Cutting holes in roof sheets for radial stays in place of drilling, reaming holes, after burning, with reamer and spindle.
Cutting out fireboxes complete, and parts of boilers.
Cutting superheater flues.
Cutting out countersunk rivets and removing rivet heads.
Cutting off staybolts and cutting out staybolts for removal of broken bolts.
Burning out staybolt burs in place of drilling or punching.
Cutting off staybolt ends for driving.
Cutting off radial stay ends for driving on both sides in place of having them set.
Cutting around tubes on back tube sheet when back end is to be removed, taking part of tube sheet and removing tubes from the boiler with traveling crane.

H. Eisele (Wabash)—In removing fireboxes we cut them up in strips 18 in. to 20 in. wide for the full length of the inside of the box with the cutting torch, the staybolts being drilled on the outside. After the boiler is removed the firebox is taken to the boiler shop and laid on its back and clamped. A big crane is then used to pull out the strips.

G. H. Logan (C. & N. W.)—We cut out the firebox in sections, using a long cutting torch. After a good sized hole is made, one-fourth of the sheet can be cut out at one time. The crown sheet is removed last.

Mr. Byers—The cutting is the most profitable process in the shop. We never drill a hole on steel running boards. A five-piece firebox was welded before application at a cost of $527.24 labor and material. The holes are drilled for the mudring before the side sheet and the door sheet and tube sheet are welded in. When a tube sheet or door sheet warps after being welded it is heated and pulled back to shape. We have 57 fireboxes in service that are entirely welded—no seams in them—and we have no trouble with them. When we put in a patch we put in a round one and dish it slightly along the edges. The welder starts at one end and keeps a little wedge driven ahead of the hammer. We do not weld any bridges in back tube sheets. We cut the small tubes out of the boiler with a light steel roller and the large ones with acetylene. We have welded 15 sets of tubes at the firebox end and did not have very good success with them. We have still got 6 or 7 of the 15 in service. One of them has made 90,000 miles and another one 75,000, but they are both ready for shopping. We are still experimenting on welding tubes with oxy-acetylene. We apply our staybolts from the inside of the firebox, and one cutter can cut the entire firebox in six hours. That leaves them nice and square and they are set and ready to drive. We weld the staybolt holes in the outside casing in order to reduce the size of the hole. Tire steel chips are used for filling in flat spots.

CLOSING EXERCISES

During the Thursday session an address on the "Selection of Men and Their Promotion," was made by Roy V. Wright, editor of the *Railway Age Gazette, Mechanical Edition*. The necessity of having the officers and foremen study their men more critically was emphasized. An address on the same subject, which was made in Chicago, June 28, is printed on another page.

The following officers were elected for the ensuing year: President, L. A. North, superintendent of shops, Illinois Central, Chicago, Ill.; first vice-president, Walter Smith, general foreman, Chicago & North Western, Deadwood, S. D.; second vice-president, W. T. Gale, foreman, Chicago & North Western, Chicago, Ill.; third vice-president, W. G. Reyer, general foreman, Nashville, Chattanooga & St. Louis, Nashville, Tenn.; fourth vice-president, C. L. Dickert, assistant master mechanic, Central of Georgia, Macon, Ga.; secretary-treasurer, William Hall, foreman, Chicago & North Western, Winona, Minn.

The Cost of Employing Incompetents.—At a recent gathering of machine tool builders it was stated that it costs $30 to $35 to engage a workman, test him and discharge him if inefficient. This figure is based on the records of a large manufacturing plant, and it is easy to see how much can be lost per annum if great care is not exercised in selecting the new hands.—*Power*.

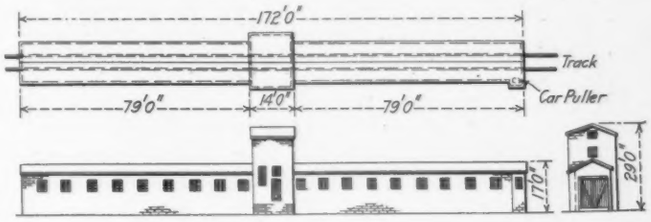
NEW DEVICES

PLANT FOR SANDBLASTING STEEL CARS

To meet the demand for an effective and economical means of cleaning steel cars from mill scale, rust, paint, etc., the sand blasting plant shown herewith has been developed by the Mott Sand Blast Manufacturing Company, New York and Chicago. In designing this system the purpose has been to so arrange the apparatus that the sand may be handled by gravity, thus eliminating the use of elevating machinery, and reducing the cost of the structure required to house the equipment, and to provide an effective system of ventilation with a minimum expenditure of power.

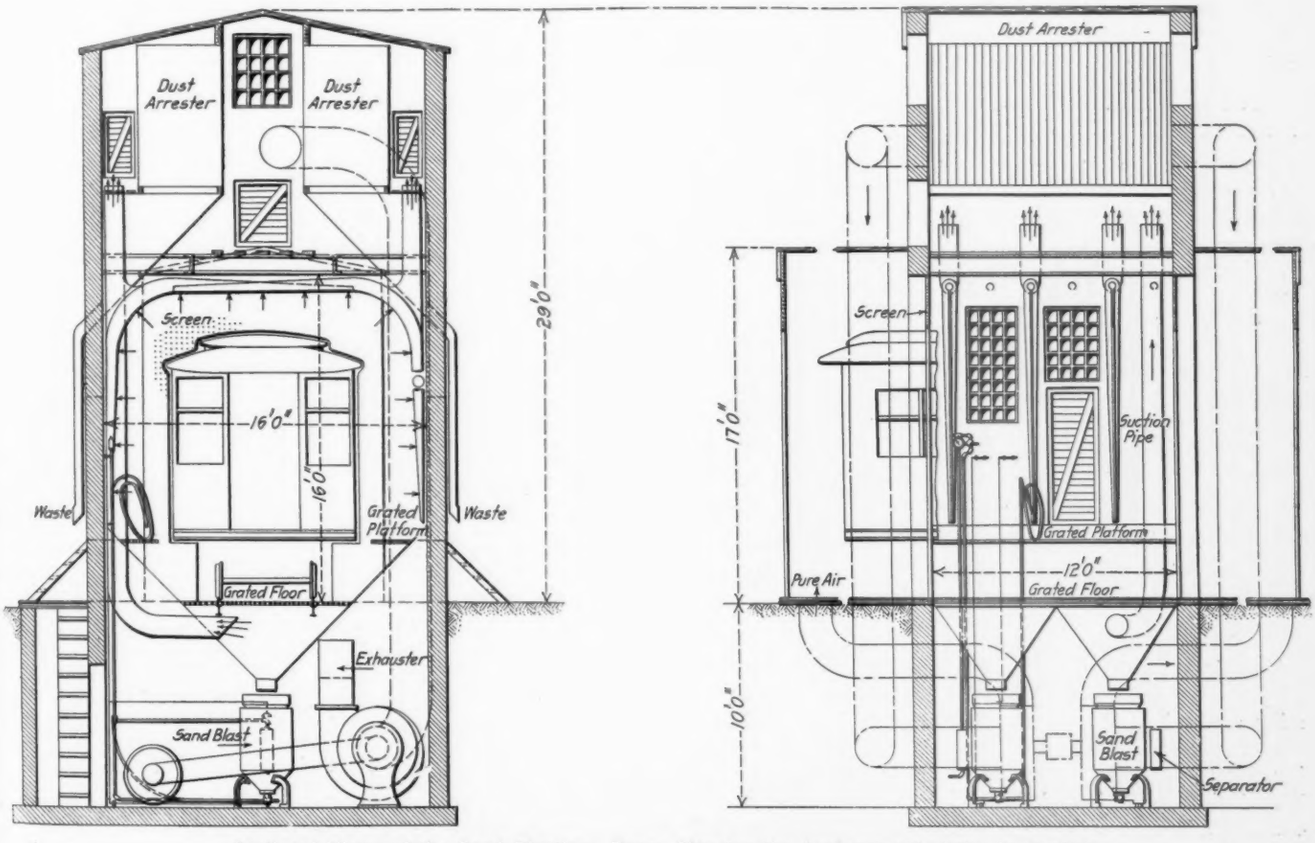
The plant is installed in a building consisting of a sand blast room 12 ft. long inside, and of sufficient width to allow operators to work on both sides of the car, to each end of which is connected a shelter bay of sufficient length to house a car of the greatest length which the plant will be required to handle. The portion of the building containing the sand blast room is a two-story structure with a basement, the latter containing the sand blast machines and the motor-driven double exhauster, while the second story contains the dust arrester.

The openings between the sand blast room and the shelter bays are closed by soft curtains designed to conform closely to the outline of the sides and roof of the car. The entire floor of this room is a steel grating, below which are hung two steel hoppers for collecting the abrasive material as it drops from the cars and directing it to the top of the two sand blast machines, one of which is placed directly below each hopper. The sand blast machines are fitted with screens and automatic filling valves, and by this arrangement all elevating machinery is dispensed with. Sectional grating platforms extend along either side of the room, near the bottom of the car body. These are for the use of the operators working on car bodies; in order to provide access to the underframes or the trucks, or to make the room available for cleaning structural work the sections are hinged to the side walls so that they may be either in part or all raised against the sides of the building.



Type of Building Required to House the Mott Sand Blasting Plant

The dust arrester in the second story of the blast room is of the manifold cloth screen type and removes all dust from the air passing through it. Hoppers for the collection of the dust are built in below the screens, and are suitably connected to waste chutes extending out through the sides of the building. Suction pipes from the dust arrester lead to a double exhauster in the basement below the blast room. The cleaned air is discharged from these exhausters into the shelter bays, about 10 ft. back from the blast room, thus causing a slight increase of pressure in the shelter bays and inducing a steady flow of air



Sectional Views of the Sand Blasting Room, Showing the Arrangement of the Apparatus

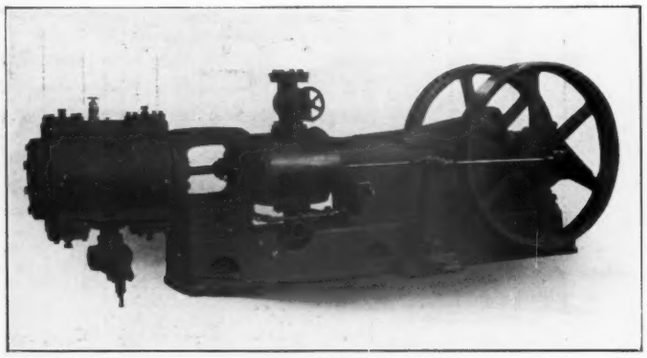
from them into the sand blasting room. The air passes through the small openings between the curtains and the car body and prevents dust from entering the shelter bays. To the intake side of the dust arrester are connected a number of pipes with slotted openings running down either side of the room and across the roof of the car. Eight of these branches are used, and through them the dust is collected and withdrawn to the arrester. Other suction pipes are placed in the hoppers above the sand blast machines for withdrawing the dust from below the floor.

By closely confining the sand blasting operations in a 12-ft. room and by collecting the dust close to its point of origin it is possible to secure adequate ventilation with a low requirement for power. It is claimed that only 25 hp. is necessary to effect eight changes of air per minute in this room. The ventilation is also materially benefited by the return of the clean exhaust from the fans into the shelter bays on either side of the sand blast room.

The sand blast machines are fitted with ⅜-in. or ½-in. nozzles, and when supplied with air at a pressure of 80 lb per sq. in. will clean from four to eight square feet of surface per minute, or a total of 8 sq. ft. to 16 sq. ft. per minute for both machines. The apparatus is designed to use any abrasive material, preference being given to metal abrasives as being cheaper and decreasing the amount of dust created.

SMALL STEAM DRIVEN AIR COMPRESSOR UNIT

The demand for higher efficiency and the increasing tendency toward the use of higher steam pressures has led to the development of a new type of small steam driven, half-speed air compressor by the Ingersoll-Rand Company, New York. This machine is similar in general design to an older small steam unit built by the same company, but embodies a number of improvements which are claimed to give it a higher efficiency in the air end and a considerably lower steam consumption.



Small Air Compressor Unit

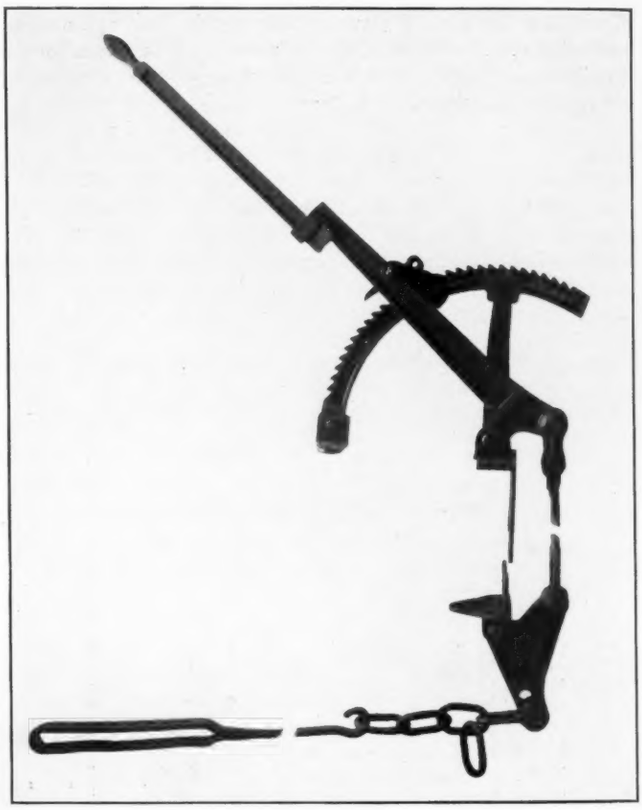
The air valves used on this compressor are of the recently adopted Ingersoll-Rogler type and are independent of any operating mechanism. They give high compression efficiency, and are almost silent when operating at high speeds. Before adopting this valve a thorough test was conducted to determine its life. This test consisted in running a 12-in. stroke compressor 400 revolutions per minute over a period of one year, during which time no valves were broken and no adjustments required.

The distribution of steam is controlled by balanced piston valves. This type of steam valve was adopted to facilitate the operation of the unit at higher speeds, and with high steam pressures; it is also adapted to the use of superheated steam. The automatic cut-off control is regulated by a centrifugal flywheel governor which shortens or lengthens the stroke of the piston valve. This is supplemented by an automatic air unloader.

In the design of the machine as a whole materials are disposed with special attention to secure rigidity without excess weight and special provision has been made for ready adjustment of all parts, without loss of time. The bearing parts are oiled by an automatic splash system of lubrication.

LEVER HAND BRAKE

A freight car hand brake in which the usual type of brake shaft and wheel is replaced by a tension rod and lever has now



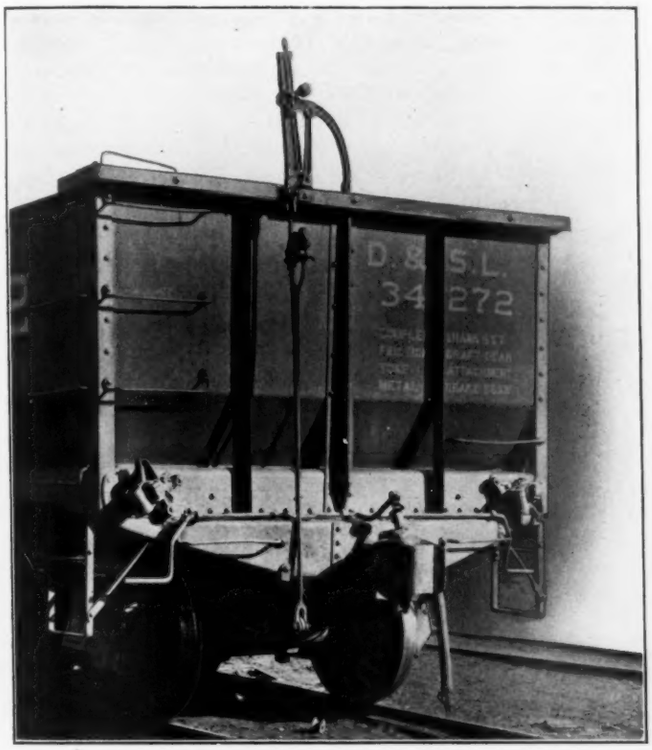
Details of Lever-Operated Hand Brake

been in service on a number of cars for more than a year and a half. It is known as the Klasing car brake and is operated by a lever having an extension handle, to which is secured a pawl engaging ratchet teeth on a vertical quadrant. The lever is pivoted to the quadrant and the latter is secured to the top of the car so that the short end of the lever projects over the end of the roof. A bell crank is secured to the end sill directly below the end of the operating lever to which one of its arms is connected by a tension rod. The other end of the bell crank is connected to the brake rod, which is provided with an adjustable jaw for taking up slack.

The purpose of this design is to facilitate quick action in the application of the brake and it is claimed to eliminate an element of danger to the brakeman incurred in changing his position when operatng the usual type of hand brake. The pawl is controlled by a small weight, thrown forward by hand to engage the ratchet.

This brake is sold by D. R. Niederlander, successor to the Adreon Manufacturing Company, Security Building, St. Louis, Mo. It may be applied to the top of box cars, to the top of gondolas and to the end sills of baggage and tank cars, and it

is equally suitable for application to box or gondola cars with end steps. The travel of the bell crank is 13 in. which is more

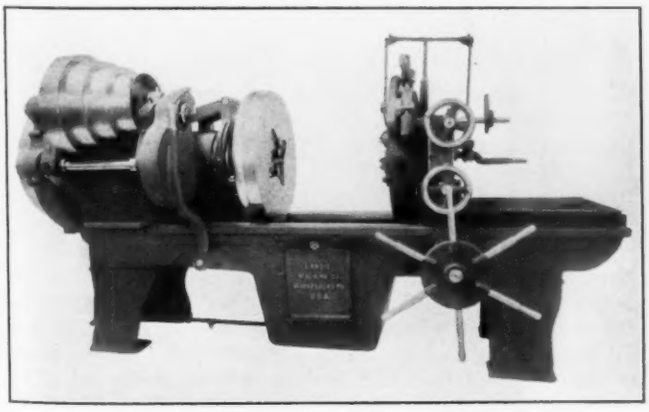


The Brake Applied to a Gondola Car

than provided by the air brake. The maximum height of the lever above the roof of a box car is about 15 in. with the extension handle collapsed.

PIPE THREADING AND CUTTING MACHINE

The Landis Machine Company, Waynesboro, Pa., has recently developed and placed on the market a line of pipe threading and cutting machines, which are attracting considerable attention. These machines are designed to use the Landis stationary type pipe die heads, which cover a wide range with but one set of



Machine for Threading and Cutting Pipe

chasers. The gripping chucks have universal adjustments and on the 4 in. and 6 in. machines are lever operated.

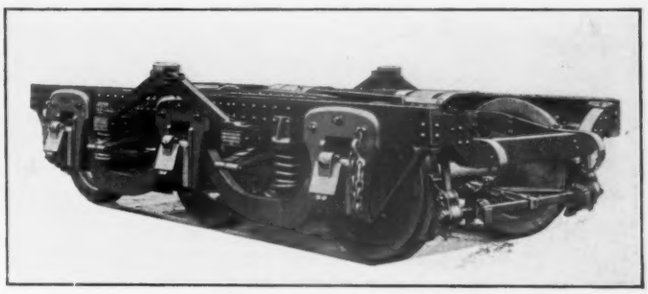
The most noteworthy feature of this type of machine is the ease with which it may be adjusted for the different sizes of pipe. This is due to the fact that the die head and gripping chuck have universal diametrical adjustments, and but one set of chasers is required to cover the range of each die head.

Size	Range	Number of Heads	Standard Chaser Equipment
4 in.	1 in. to 4 in.	2	1 set 11½ pitch 1 set 8 pitch
6 in.	1 in. to 6 in.	2	1 set 11½ pitch 1 set 8 pitch
8 in.	2½ in. to 8 in.	2	1 set 8 pitch (2½ in. to 4 in.) 1 set 8 pitch (4 in. to 8 in.)

The accompanying table gives the principal data for the different sizes of the machines. The machines are fitted with reaming attachments and cutting off tools, and the makers claim they will thread, ream and cut pipe in one continuous operation at a speed double that possible on any other pipe machine. Several of these machines have already been placed in service.

ROLLED STEEL TRUCK FRAMES

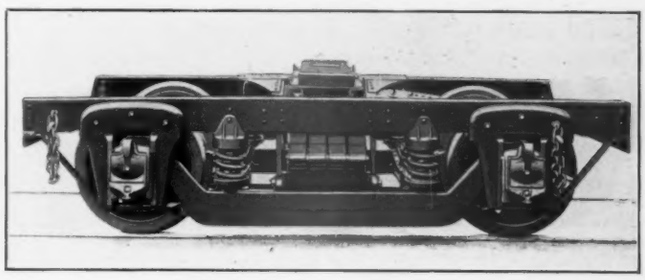
The American Car & Foundry Co., New York, has developed designs of four-wheel and six-wheel trucks for passenger service, having frames made up almost entirely of standard rolled



Six-Wheel Truck with Rolled Steel Frame

sections. The idea in designing these trucks was to reduce both first cost and maintenance troubles. Repairs to the frames can be made at almost any shop and experience has shown that under ordinary service conditions, heavy repairs requiring special work and tools are unnecessary.

In both designs the attempt was made to secure maximum strength and service ability with a minimum weight. The frame for the four-wheel truck weighs approximately the same as the old wooden frame having iron flitch plates, while there is a marked advantage as regards strength and rigidity. All rivet holes are reamed to size and the more important rivets



Four-Wheel Truck with Rolled Steel Frame

are machine driven. Large gusset plates are used to connect the cross members to the truck sides and the friction plates for the bolsters are located on the bolster hanger brackets, thus removing the lateral strain from the cross members. The brake hanger bracket is secured to a pressed arm, which is supported by the truck side and the cross member gussets. The bolster hanger is extra long and the pins are of large diameter in order to reduce wear. Either the usual design of inside

hung brakes or the American Brake Company's design of clasp brakes may be used with this truck.

The six-wheel truck has been found to meet all the requirements of high-speed passenger service, trucks of this design having been used for some time under heavy passenger equipment cars, including dining cars. It is claimed that frames for the six-wheel truck are approximately 3,000 lb. lighter per car than the usual design of cast steel frame, this advantage being obtained because in the rolled steel design the metal can be placed to better advantage at the points of greatest stress. The American Brake Company's clasp brake arrangement can be used with this truck, as well as with the four-wheel design.

EXTENSIBLE VESTIBULE TRAP DOOR

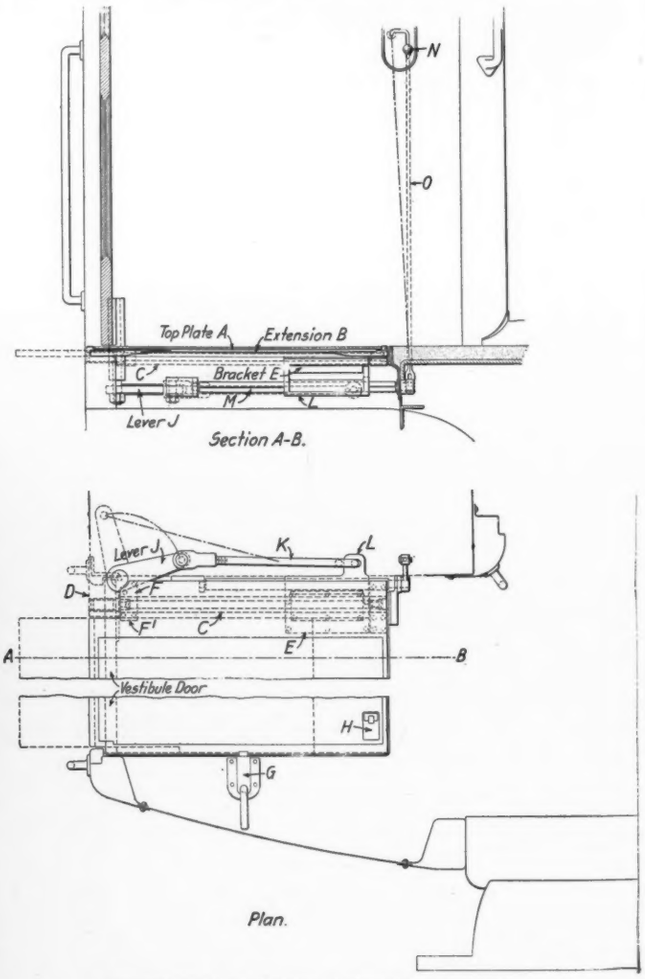
The Pennsylvania Railroad has built high station platforms at its New York terminal, at Manhattan Transfer, Rahway and North Philadelphia, and has similar platforms under construction at Wilkinsburg and Johnstown on its Pittsburgh division. It is often impossible to build tangent platforms, owing to the physical conditions at stations and a difficulty has arisen in connection with the adoption of the high platform where it is built

Trap Extended at a High Station Platform

on a curve, owing to the gap between the car and the platform.

With a view to overcoming this difficulty the Pennsylvania has equipped for trial a steel vestibule car with an extensible trap door patented by Elwood H. Sickles, 213 Woodside avenues, Narberth, Pa., which is designed to bridge the gap between the car and the station platform. The operation of this device is practically automatic. When the trap is down the opening of the vestibule door causes the sliding portion to extend beyond the side of the car; closing the door returns it to its normal position. When the trap is to be raised for the use of the step, or when the brakeman opens the door while the train is moving the trap should not be extended. To provide for this feature a small handle is set flush in the end of the car body, by means of which the connection between the door and the trap extension may be disengaged.

The extension trap in outward appearance is like the ordinary trap, and consists of a rubber covered top plate *A* and an ex-



Arrangement of Sickles Extensible Trap Door

tensible portion *B*, which is built in the familiar panel pattern and acts as a support for the top plate. The two parts are hinged on the rod *C* so they act together when the trap is raised for the use of the step. The hinge rod is hollow and accommodates the flat springs which are adjusted at the bracket *B* to obtain the proper tension. The extensible portion of the trap is supported by bracket *E*, which slides on the hinge rod and lug *F'* attached to the top plate bracket *F*. When the trap is extended, owing to the fact that it is supported at one side on lug *F'*, and at the opposite side on the usual angle iron ledge, the extended portion is prevented from deflecting when a passenger steps on it. Spring catches *G* and *H* of the usual type are used to hold the trap door down when the door is closed and to hold it up against the vestibule door when it is raised for the use of the steps.

The operating device consists of a bell crank lever *J* attached to the bottom of the vestibule door, the connecting rod *K* and the cam *L* which slides on the square shaft *M*. The rod shown at *O* is attached to the end of a lever which turns the square shaft. The upper end of this rod extends through a slot in the end of the car and is provided with a knob by means of which it may be raised to the position shown by the dot and dash centerline, or returned from that position to its normal position as shown in the drawing. In the latter position the cam *L* on the

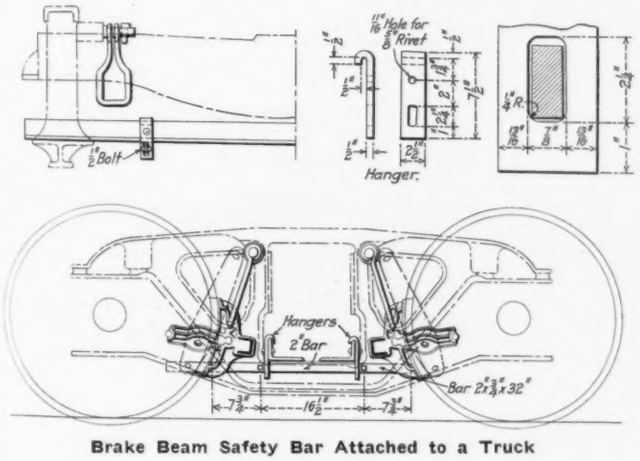
square shaft engages a taper lug on bracket *E*, through which the trap extension is moved by lever *J* and connecting rod *K* when the door is opened. When the knob *N* is in its upper position the cam is disengaged from the bracket on the extension and opening the door has no effect upon the trap. The cam is so designed, however, that when released its front finger is always in position to prevent the trap from being extended independently, thus making it impossible for the trap to be out when the door is closed. The trap is so arranged that it is impossible to raise it when extended, due to interference between the corner of the extension and the hinge bracket *D*. The trap is designed with a uniform extension to take care of the gap at platforms built on curves as sharp as 6 deg. On lighter curves the extension may slightly overlap the platform, the latter, of course, being kept a small step below the floor of the car. Owing to the varying height of the car floors above the top of the rail, due to differences in springs, etc., it has been found impossible to maintain the car floor at a level with the station platform.

It is unnecessary to provide extra trainmen to attend to the operation of this trap, as with the small hand lever set in proper position, the opening of the vestibule door, whether accomplished by the trainman or passenger, will cause the trap to extend. Owing to the fact that the stop plate does not slide, it is, of course, impossible for passengers to be thrown by the movement of the extension.

BRAKE BEAM SAFETY HANGER

The accompanying drawing shows a type of brake beam safety hanger which has recently been patented by Edward O. Elliott, chief draftsman, Philadelphia & Reading, Reading, Pa. The device is extremely simple and offers practically no obstruction to the removal and replacement of the beam.

The safety hanger is attached to the spring plank and under normal conditions is entirely free from contact with the brake beam or brake head. It consists of a rectangular bar 2 in. by ¾ in. in section and 32 in. long. This is supported by two



Brake Beam Safety Bar Attached to a Truck

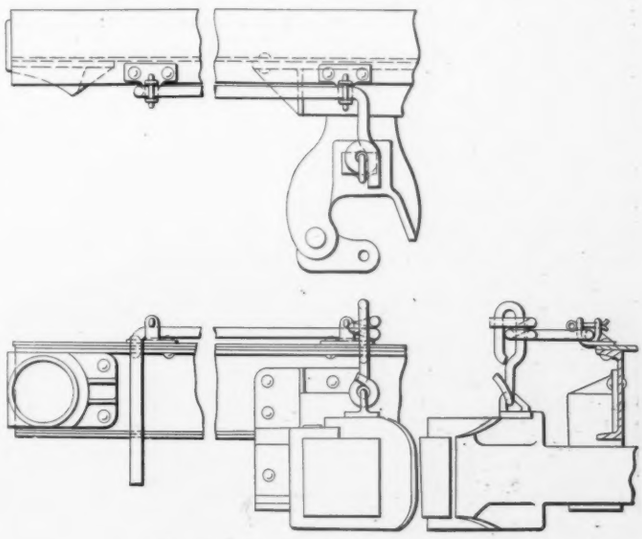
hangers lipped over the vertical flange of the spring plank and riveted to it. These are shown in detail in the drawing. The bar is slipped into place through slots in the hangers and secured by means of ½-in. bolts placed through the bar at either end just outside of the hangers. In this position the device offers effective support to the brake beam should the brake-beam hangers fail. Should the removal of a brake beam be desired the bar may be slid back at one end as shown in the drawing by removing one of the ½-in. bolts, in which position it offers no obstruction to the removal of the beam.

This safety hanger is in use on the Philadelphia & Reading.

SIMPLE COUPLER RELEASE RIGGING

The coupler release rigging shown herewith was designed to eliminate as many parts as possible and to facilitate the application of the device to the eye of the coupler lock and the end of the car. It is known as the Singlelink release rigging, from the fact that but one piece is used between the uncoupling lever and the eye of the coupler lock. The upper end of the link is made with an elongated eye, which provides for all motion of the coupler relative to the end sill, and the lower end is provided with an open eye.

The uncoupling lever is secured to the end sill of the car by means of open brackets which are closed by cotter pins. In applying the rigging to the car the lower end of the link is



Coupler Rigging Having Few Parts

first hooked into the eye of the coupler lock; the lever being then placed in the brackets and secured by the cotters. The lever connection to the link is provided with a tail which serves to prevent the link from turning and sliding out of place.

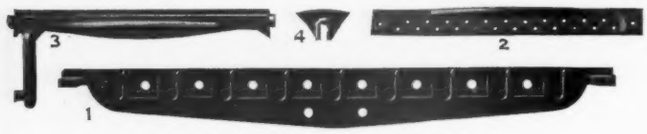
HULSON LOCOMOTIVE GRATE

A large total air opening in locomotive grates with not too wide an opening between the fingers of the grate is an acknowledged advantage. At the recent convention of the International Railway Fuel Association it was stated that from a canvass of 21 roads, it was found that the percentage of the area of the air openings in the grate to the total grate area varied from a minimum of 28.5 per cent. to a maximum of 49.6 per cent., and that the average was 37.2 per cent., with 1 in. openings between the fingers, for bituminous coal burning engines. It was also stated that the Seaboard Air Line strongly favored the table grate on account of its large air opening.

The illustrations show a grate for locomotives which provides an air opening area of 55 per cent. of the total grate area, with ⅝ in. openings between the fingers, and with possibilities of a larger percentage of air space where the conditions permit. This grate is made by the Hulson Grate Company, Keokuk, Iowa. It has been installed in a large number of stationary plants and has been made standard on the locomotives of one railway. The experiences of those who have it in service indicate that with the large amount of air opening in the grate it has been possible to more thoroughly consume the coal, thus producing less smoke and keeping cleaner fires. Many cases have also been found where a cheaper grade of fuel can be

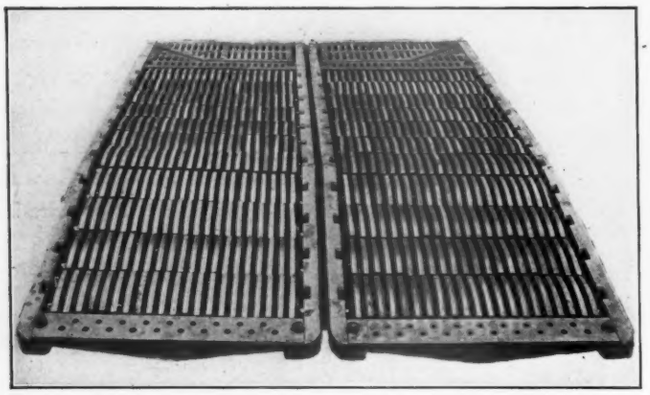
used with this grate. Because of the better consumption of the fuel several of the users report considerable savings in coal consumption.

Aside from the large amount of air space provided by this grate the mechanical features are of considerable interest, the purpose of the manufacturers being to provide a grate of as simple construction as possible, with a minimum amount of trou-



Parts of the Hulson Grate

ble to repair. The details of the grate are shown in one of the illustrations. No. 1 is the side bar; No. 2 the tie bar; No. 3 the finger bar, and No. 4, the finger. The fingers are all loose on the finger bar, which permits expansion or contraction without affecting the finger bar. The fingers slide on to the finger bar from the end, being held by means of a key cast into the bar and fitting into a keyway in the fingers. This construction has been adopted to make possible the renewing of the fingers, should they become broken, at a very small cost, the finger bar simply being lifted from the side bar and the broken finger replaced. It will also be noted that the tops of the fingers are



Hulson Grate for 108 in. by 66 in. Locomotive Firebox

curved so that when the grate is rocked slightly, a rubbing action will be produced on the fuel bed which dislodges the fine ash without disturbing the fire or allowing the unburned fuel to drop into the ashpan. By shaking the grate for the full stroke, however, it is possible to dump the fire. The construction of these fingers also tends to raise the bed of the fire sufficiently high from the mechanism of the grate to keep it from being subjected to the severe heat. It is also claimed that the large percentage of air space in the grate permits the use of a larger exhaust nozzle, since as much draft will not be required to pull the air through the grate bars. With the 5/8 in. openings there will be a more even distribution of the air through the fuel bed, which permits of a lighter fire being carried.

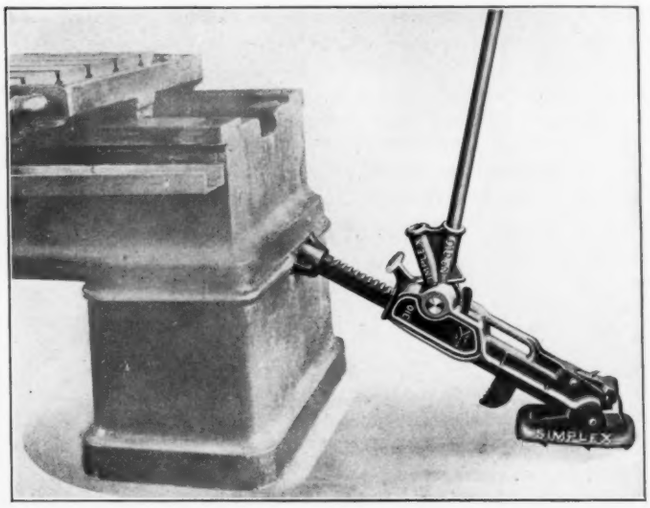
RAILWAY EXTENSION IN CHINA.—The Chinese Government proposes to construct railway lines outside the Great Wall. The termini of the proposed lines are the several places which will be opened as trade ports, such as Chifeng, Taonanfu, Dolonor, etc. The first line is from Peking to Jehol, a distance of 140 miles, with a line from Jehol to Chifeng of 130 miles, and another one of 170 miles from Chingchow to Chifeng. The other lines are from Kalgan to Dolonor of 150 miles, and from Dolonor to Chifeng of 200 miles. These lines will be connected with the Peking-Mukden and the Peking-Kalgan railways. The scheme is now under consideration by the Ministry.

EMERGENCY JACK WITH ADJUSTABLE BASE

The jack shown in the illustration is adapted to a variety of purposes about the shop, on the repair track and in emergency use generally. It is known as the Simplex emergency jack and is manufactured by Templeton, Kenly & Co., Ltd., Chicago.

The standard or frame is a heavy malleable iron casting well reinforced with ribs against stresses in all directions. It is hinged to the base by a steel pin, which is relieved of shearing stress by the fitted circular bottom of the frame, which rests upon shoulders in the base. The rack bar and cap are of heavy drop forgings, the top of the cap being recessed to fit the links of a chain, which may be used in shifting heavy material.

The double socket of crucible steel makes it possible to operate

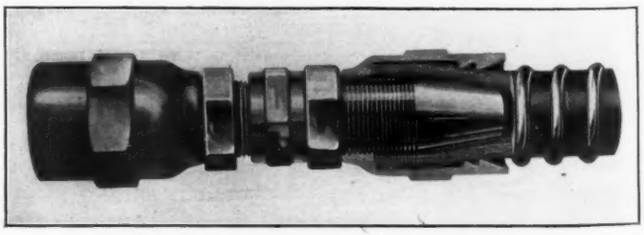


Emergency Jack with Adjustable Base

the jack at any angle from the vertical to 30 deg. from the horizontal. A heavy trunnion bearing supports the socket. A trip at the back of the base is provided to hold the frame rigid in a vertical position, the releasing of which permits the pivoting of the body on the base. The equipment of the jack includes five feet of chain and a five-foot steel lever bar. The jack has a capacity of 15 tons.

NATIONAL HOSE COUPLING

The accompanying illustration shows a new type of hose coupling recently placed on the market by the National Hose Coupling Company, Peoples Gas Bldg., Chicago, Ill. This coupling provides a positive means of applying a coupling to a rubber hose. As indicated in the illustration, the hose is inserted in the cor-



Sectional View of the National Hose Coupling

rugated socket and a steel taper expander is screwed into the socket, forcing the hose out against the corrugation. The ends of the socket and the expander are rounded to prevent injury to the hose. No special tools are required for application.

RECORDER FOR MEASURING FLOW OVER WEIRS

With any type of weir or orifice the rate of flow is dependent upon the head, and once the law of the weir or orifice is known, it may be calculated directly. For most purposes of measurement, however, mere knowledge of the rate of flow at a given instant is not sufficient, but continuous or total results are wanted. This has led to the development of various types of flow recorders, one of the most recent of which, the Cochrane type, is illustrated herewith.

The Cochrane Flow Recorder

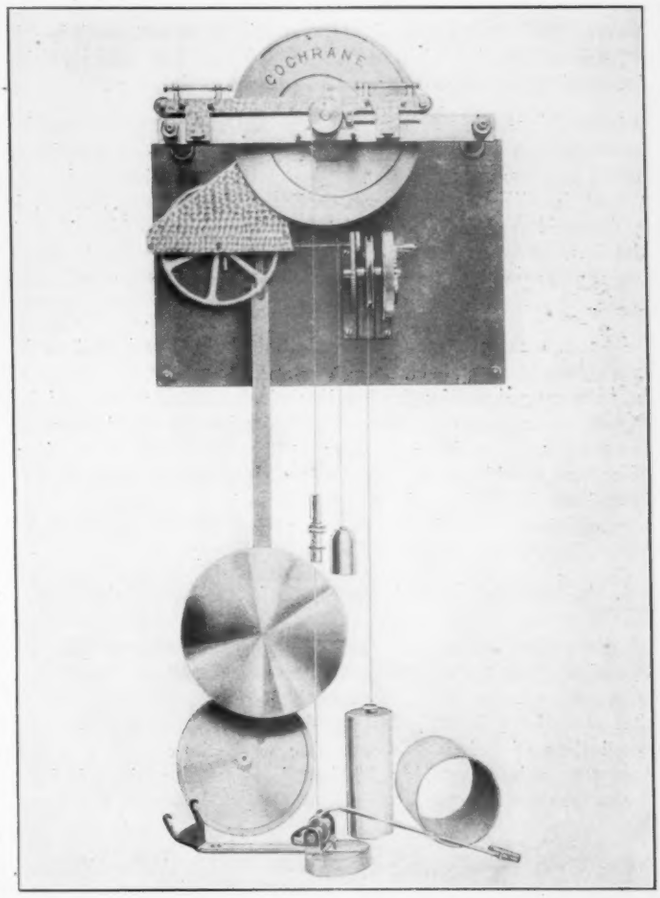
In such recorders there is a float which moves vertically in response to changes in head. If the motion of the float is employed directly to actuate the recording device, so that the action of the recording pen is directly as the motion of the float, or in proportion to it, a record of rate of flow can be obtained, but the divisions on the chart are not in general equal for equal increments in the rate of flow. It is therefore necessary to incorporate some kind of translating or modifying mechanism between the motion of the float and the motion of the recording pen. This translating mechanism is ordinarily a cam.

In the Cochrane flow recorder, the cam is laid out as a spiral on a flat circular plate, and the multiplying mechanism consists of a small drum mounted upon the spindle of the cam, and having wrapped about it a thin metal cable which is attached to the float spindle, a counter-weight on another cable serving to keep the first cable taut. The spiral groove is cut into the surface of the disk, and is so arranged that the part of the cam corresponding to the low heads is near the center of the disc, and the part corresponding to high heads is near the periphery of the disc. To accommodate the recorder for use with weirs of different heights it is only necessary to substitute cable drums of the proper respective diameters. One cam serves for all weirs, having the same law connecting head and flow, and hence it has been commercially feasible to devote considerable expense to the mechanical means of reproducing this cam to insure accuracy.

The elimination of friction and back-lash are prime requisites in the design of such apparatus. Back-lash has in the present case been eliminated by the use of a cable drum instead of the gear and pinion drive formerly employed, while friction has been reduced as much as possible by mounting the spindle of the cam upon anti-friction rollers. Accuracy is also promoted by the use of a large, powerful float, and where an enclosed weir chamber is employed, and the float stem must pass through a packing gland, the latter should be of the self-aligning type.

The pen carriage is provided with large rollers or wheels, which rest upon horizontal ways, so that the cam follower which is attached to the pen carriage moves diametrically to the cam disc. The construction is such that the cam follower cannot be accidentally displaced from the cam slot. The chart being driven uniformly by a clock, the pen not only records the rate of flow at each instant, but the area under the pen trace is proportional to the total flow for any elapsed period. Many users, however, desire to obtain the total flow directly, without the use of a planimeter, and for this purpose an integrating attachment has been added.

Only one clock is employed, a powerful, weight-operated pendulum movement, making 80 beats per minute, as against the 240 or 300 usual with hair-spring escapements.



Mechanism of the Flow Recorder with Drum and Recording Pen Removed

This flow recorder, while originally designed for use with V-notch weirs, may be used with rectangular weirs or submerged orifices. It is regularly supplied in connection with the Cochrane V-notch meters and metering heaters, manufactured by the Harrison Safety Boiler Works, Philadelphia, Pa.

NEWS DEPARTMENT

The Chicago & Alton has increased the working time at its shops at Bloomington, Ill., from eight to nine hours a day.

On July 22, 1915, the Grand Trunk Pacific had completed the installation of oil-burning locomotives on the mountain sections of its line and they were operated for the first time in passenger service. Oil is being used for fuel over 719 miles of main line, from Jasper to Prince Rupert, B. C.

The railway department of the American Federation of Labor has issued a notice officially calling off the strike of the mechanical department unions which was declared on the Illinois Central, the Harriman Lines and the Pere Marquette in 1911. From the point of view of the railways the strike was terminated over three years ago.

George W. Wren, a carpenter in the motive power department of the Ann Arbor Railroad at Owosso, Mich., has been in the service of that company for about 27 years and is still actively employed, although he was 55 years old before he entered the service. He is now in his 82nd year and is still actively engaged in his occupation of building and repairing locomotive pilots, hand cars and gasolene section cars.

The Erie Railroad has sold four of its largest steamships which are in use on the Great Lakes, and the ownership of which the company has to divest itself in accordance with the recent decision of the Interstate Commerce Commission. It is understood that the boats will be cut in two and taken through the St. Lawrence river to the Atlantic ocean, there to be again put together and to be used by the purchasers in the coastwise trade.

The San Pedro, Los Angeles & Salt Lake has issued to its employees a special bulletin on trespassing, urging them to begin a campaign of agitation in their individual circles of influence to arouse the public to a realization of the dangers of trespassing. The bulletin says: "The Salt Lake route is a safe road to ride upon. In the last eight years no passengers have been killed in train accidents. It is a very unsafe road to walk upon. During the same period 101 trespassers have been killed."

J. A. McCrea, general manager of the Long Island, says that it is only by the rarest chance that there was not a series of disastrous accidents to automobiles at grade crossings on that road during the week ending June 28. Every day he receives reports to the effect that the crossing gates at this or that place have been broken by drivers who thought more of speed than of safety. In that one week there were a dozen or more such cases. Mr McCrea has issued a list of these "near accidents."

In recognition of his ability in designing a special tool holder for use in the Sayre shops of the Lehigh Valley, Edward Seddon, a machine foreman, has been given a cash bonus by the railroad company. High speed tool steel is very expensive material. Mr Seddon built a device by which tool holders require only a cutting edge of high speed tool steel, thus making possible a large economy. He has also recently designed a number of other special devices for use in railway shops, and it is as a mark of appreciation of the economies he has made possible that the company has awarded the bonus.

MEETINGS AND CONVENTIONS

International Railroad Master Blacksmiths' Association.—The twenty-third annual meeting of the International Railroad Master Blacksmiths' Association will be held at the Hotel Walton, Philadelphia, August 17, 18 and 19, 1915. The following subjects will come before the meeting for consideration: Flue Welding; Making and Repairing Frogs and Crossings; Carbon and High-Speed Steel; Tools and Formers; Electric Welding; Drop Forging; Spring Making and Repairing; Piece Work and Other Methods of Having Work Done; Making and Repairing Locomotive Frames; Oxy-Acetylene Process for Cutting and Welding; Case Hardening; Heat Treatment of Metals; Best Methods of Reclaiming Scrap; Shop Kinks; New Subjects. Committee reports on most of these subjects have been prepared for presentation at the meeting.

Chief Interchange Car Inspectors' and Car Foremen's Association.—The seventeenth annual convention of the Chief Interchange Car Inspectors' and Car Foremen's Association of America will be held at Murphy's Hotel, Richmond, Va., September 14 to 16, inclusive. As is customary, the problems in the interchange of railway cars and the M. C. B. rules governing the interchange of cars will be discussed.

Mastar Car and Locomotive Painters' Association.—The forty-sixth annual convention of the Master Car and Locomotive Painters' Association of the United States and Canada will be held at the Hotel Statler, Detroit, Mich., September 14 to 16, inclusive. A paper will be read by Henry A. Gardner, assistant director of the Institute of Industrial Research of Washington, D. C., on Metal Protection. Committee reports will be made on Flat Color vs. Enamel Color; Effect of the Design of Present Steel Passenger Equipment on the Protective Coating; Price vs. Quality in Buying Paint Material; Varnish Finish vs. Varnish Enamel Color; Piece Work; Maintaining the Interior of Steel Passenger Cars.

The following list gives names of secretaries, dates of next or regular meetings, and places of meeting of mechanical associations.

AIR BRAKE ASSOCIATION.—F. M. Nellis, 53 State St., Boston, Mass.

AMERICAN RAILROAD MASTER TINNERS, COPPERSMITHS AND PIPEFITTERS' ASSOCIATION.—W. E. Jones, C. & N. W., 3814 Fulton street, Chicago.

AMERICAN RAILWAY MASTER MECHANICS' ASSOCIATION.—J. W. Taylor, Karpen building, Chicago.

AMERICAN RAILWAY TOOL FOREMEN'S ASSOCIATION.—Owen D. Kinsey, Illinois Central, Chicago.

AMERICAN SOCIETY FOR TESTING MATERIALS.—Prof. E. Marburg, University of Pennsylvania, Philadelphia, Pa.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—Calvin W. Rice, 29 W. Thirty-ninth street, New York. Annual meeting, December 7-10, 1915, New York.

ASSOCIATION OF RAILWAY ELECTRICAL ENGINEERS.—Joseph A. Andreucetti, C. & N. W., Room 411, C. & N. W. Sta., Chicago. Annual meeting, October, 1915.

CAR FOREMEN'S ASSOCIATION OF CHICAGO.—Aaron Kline, 841 North Fiftieth Court, Chicago; 2d Monday in month, except July and August, Lytton building, Chicago.

CHIEF INTERCHANGE CAR INSPECTORS' AND CAR FOREMEN'S ASSOCIATION.—S. Skidmore, 946 Richmond street, Cincinati, Ohio. Annual meeting, September 14-16, 1915, Richmond, Va.

INTERNATIONAL RAILWAY FUEL ASSOCIATION.—C. G. Hall, 922 McCormick building, Chicago.

INTERNATIONAL RAILWAY GENERAL FOREMEN'S ASSOCIATION.—William Hall, 1126 W. Broadway, Winona, Minn.

INTERNATIONAL RAILROAD MASTER BLACKSMITHS' ASSOCIATION.—A. L. Woodworth, Limo, Ohio. Convention, August 17, 1915, Philadelphia, Pa.

MASTER BOILER MAKERS' ASSOCIATION.—Harry D. Vought, 95 Liberty street, New York.

MASTER CAR BUILDERS' ASSOCIATION.—J. W. Taylor, Karpen building, Chicago.

MASTER CAR AND LOCOMOTIVE PAINTERS' ASSOC. OF U. S. AND CANADA.—A. P. Dane, B. & M., Reading, Mass. Convention, September 14-17, 1915, Detroit, Mich.

NIAGARA FRONTIER CAR MEN'S ASSOCIATION.—E. Frankenberger, 623 Brisbane building, Buffalo, N. Y. Meetings monthly.

RAILWAY STOREKEEPERS' ASSOCIATION.—J. P. Murphy, Box C, Collinwood, Ohio.

TRAVELING ENGINEERS' ASSOCIATION.—W. O. Thompson, N. Y. C. R. R., East Buffalo, N. Y. Convention, September 7-10, 1915, Hotel Sherman, Chicago, Ill.

PERSONALS

It is our desire to make these columns cover as completely as possible all the changes that take place in the mechanical departments of the railways of this country, and we shall greatly appreciate any assistance that our readers may give us in helping to bring this about.

GENERAL

WILLIAM H. ELSNER has been appointed chief draftsman, motive power department, of the Great Northern Railway, at St. Paul, Minn., succeeding N. R. Ross, promoted.

N. C. HOOPER has been appointed car foreman of the Grand Trunk Pacific at Smithers, B. C., succeeding A. McKinnon.

W. B. MCNIECE has been appointed car foreman of the Grand Trunk Pacific at Prince Rupert, B. C., succeeding W. Thompson.

A. MCKINNON has been appointed car foreman of the Grand Trunk Pacific at McBride, B. C., succeeding W. B. McNiece.

J. F. MOFFATT has not been appointed district locomotive foreman of the Grand Trunk Pacific, as was reported in these columns last month. The circular announcing the appointment has since been cancelled.

L. G. ROBLIN has been appointed general master mechanic of the National Transcontinental Railway and the Lake Superior branch of the Grand Trunk Pacific, with headquarters at Cochrane, Ont.

J. S. SHEAFE, master mechanic, Staten Island Lines of the Baltimore & Ohio at Clifton, Staten Island, N. Y., has been granted leave of absence for one year.

CAR DEPARTMENT

P. ALQUIST, whose appointment as general superintendent of the car department of the Missouri, Kansas & Texas at Dennison, Tex., has already been announced in these columns, was born in Stockholm, Sweden, in 1874, and came to this country in 1885, settling in Memphis, Tenn. He started his railroad career as car repairer for the Illinois Central at Memphis in the early part of 1895, working for the same road as car interchange inspector, repair track foreman and general foreman of the car department of the Memphis, Mississippi & Fulton divisions until 1910, when he left to go with the Cincinnati, Hamilton, & Dayton as general foreman of the car department at Lima, Ohio. He left that road after about eighteen months' service to go to the Pere Marquette as general car foreman at Grand Rapids, Mich., and was subsequently general inspector and chief inspector of the car department of that road. In 1913, Mr. Alquist was appointed superintendent of the car department of the Missouri, Kansas & Texas, at Sedalia, Mo., which position he held at the time of his recent appointment as general superintendent of the car department of that road.

P. Alquist

SHOP AND ENGINE HOUSE

G. FEETHAM has been appointed acting roundhouse foreman of the Intercolonial at Truro, N. S., succeeding W. Davidson.

A. H. KENDALL has been appointed assistant works manager of the Angus locomotive shops of the Canadian Pacific, at Montreal, Que.

L. C. ORD has been appointed assistant works manager of the Angus car shops of the Canadian Pacific at Montreal, Canada.

W. WELLS has been appointed general foreman of the Canadian Pacific at North Bay, Ont., succeeding A. H. Kendall, promoted.

C. WHITE has been appointed roundhouse foreman of the National Transcontinental Railway at Edmundston, N. B.

PURCHASING AND STOREKEEPING

R. A. LUNSFORD has been appointed storekeeper of the Kansas City, Mexico & Orient of Texas, with headquarters at Angelo, Tex., succeeding T. A. Pratt.

COMMISSION APPOINTMENTS

H. A. HERNDON, chief draftsman of the Fort Worth & Denver City, at Childress, Tex., has been appointed junior mechanical engineer, division of valuation, of the Interstate Commerce Commission, with headquarters at Kansas City, Mo.

NEW SHOPS

ATCHISON, TOPEKA & SANTA FE.—This company is constructing a seven-stall brick engine house at Prescott, Ariz. The work has been begun.

ILLINOIS CENTRAL.—This company will build wooden car repair shop buildings at Nonconnah, Tenn. The estimated cost of these new repair shops is about $150,000.

MAINE CENTRAL.—The contracts have been awarded and the work on the construction of additional buildings for the Maine Central shops at Waterville, Maine. The estimated cost is $60,000.

LEHIGH VALLEY.—This company will at once build a fireproof roundhouse, with stalls for fifty locomotives at Sayre, Pa. Contract for the building, which is to be of hollow tile and cement construction, has been given to Westinghouse, Church, Kerr & Company, New York. The total cost of the improvements will be $400,000, including a new turntable and accessories.

OREGON-WASHINGTON RAILROAD & NAVIGATION COMPANY.—This company will build a 12-stall roundhouse, a 40-ft. by 60-ft. storehouse, a 30-ft. by 40-ft. powerhouse, and a 50-ft. by 60-ft. machine shop at The Dalles, Ore. The powerhouse, machine shop and roundhouse will be brick buildings with mill interior, and the storehouse will be a corrugated, galvanized steel building on wood frame.

CHICAGO, BURLINGTON & QUINCY.—This company is rebuilding its blacksmith shop at Galesburg, Ill., which was recently destroyed by fire. The work is being done by company forces.

BALTIMORE & OHIO CHICAGO TERMINAL.—This company is building new engine and passenger terminal facilities at Fourteenth and Robey streets, Chicago, which will include a 33-stall roundhouse, a 300-car coach yard, a 2-story building 600 ft. long for coach yard supplies, a power plant, oil house, coaling station, sand house and office building. Contracts for the construction of these buildings have been awarded to James Stewart & Co., Chicago.

SUPPLY TRADE NOTES

The Sauvage-Ward Brake Company, Inc., New York, has recently changed its name to the Smith-Ward Brake Company, Inc.

Andrew Allen, Sr., the founder of the firm of A. Allen & Son, New York, died July 6.

George F. Alderdice has resigned as assistant general manager of sales of the Republic Iron & Steel Company, to become assistant to the president of the Brier Hill Steel Company.

J. F. McNamara has been appointed general manager of the Bayonne Steel Casting Company, Bayonne, N. J., succeeding W. E. Oakley.

The Scullin-Gallagher Iron & Steel Company, St. Louis, Mo., by a vote of its stockholders has changed its name to the Scullin Steel Company.

Thomas R. Cook, formerly assistant engineer of motive power of the Pennsylvania Lines West, has been appointed chief engineer of the Willard Storage Battery Company, Cleveland, Ohio.

Flint & Chester, Inc., New York, dealers in railway, mill and contractors' supplies, have been appointed New York sales agents for the jacks made by A. O. Norton, Inc., Boston, Mass.

H. A. F. Campbell has been appointed European representative of the Baldwin Locomotive Works, with headquarters in Paris. Mr. Campbell has been in the service of the company since 1900.

F. N. Hibbits, until July 1 superintendent of motive power of the Lehigh Valley at South Bethlehem, Pa., has been appointed assistant general superintendent of the Baldwin Locomotive Works, effective July 1.

The American Steel Export Company was incorporated in Delaware on June 29, with a capital of $200,000, to promote the sale abroad of products of the Cambria Steel Company. H. Gossen has been placed in charge of the New York office.

Paul B. Oatman, formerly manager of the Ideal Die & Tool Company, Beaver Falls, Pa., has been appointed manager of the small tools department of the Modern Tool Company, Erie, Pa.

Louis F. Beckert, a salesman in the railway equipment devision of the railway and lighting department of the Westinghouse Electric & Manufacturing Company, died suddenly of typhoid fever at his home in Pittsburgh on July 7.

L. S. Love, formerly head of the L. S. Love Machinery Company, has become associated with the Sherritt & Stoer Company, Inc., Philadelphia, Pa., dealers in machine tools and railway and machine shop equipment.

W. D. Waugh, district representative in St. Louis, Mo., of the Kalamazoo Railway Supply Company, Kalamazoo, Mich., has been appointed district representative in charge of the St. Louis office of the Detroit Graphite Company, succeeding Benjamin Randolph, resigned.

The National Hose Coupling Company, which has recently been incorporated, with Mortimer J. Silverberg as president, will manufacture a coupling which is applicable to various railway uses. The works of this company are at Kankakee, Ill., and its general offices are in the Peoples Gas building, Chicago.

R. A. Paterson, H. M. Buck and John B. Given, formerly the United Railway Specialties Company, 30 Church street, New York, have been appointed representatives of Mudge & Company, Chicago, in the New England, Eastern and Southern States. The representation of Mudge products covers the Mudge motor cars, Mudge-Peerless ventilators and the Mudge-Slator locomotive front end.

The Continental Piston Ring Company, Memphis, Tenn., has been incorporated with a paid in capital of $100,000. It will manufacture piston rings for locomotives, engines, automobiles and pumps of various kinds. The officers are B. H. Mason, president; W. P. McCadden, vice-president; R. E. Brown, secretary and treasurer, and C. R. Bryant, chief engineer.

The United States Light & Heat Corporation, Niagara Falls, N. Y., has been incorporated with a capital of $7,000,000 to manufacture machinery, batteries and apparatus for the production of electric light and heat. It is a reorganization of the United States Light & Heat Company, and will take over and continue the operation of that company's plant at Niagara Falls. G. M. Walker, A. L. Fowle and A. S. Jones, 60 Broadway, New York, are the directors.

W. Spencer Robertson, assistant to Leigh Best, vice-president of the American Locomotive Company, has been appointed secretary of the company, succeeding C. B. Denny, formerly treasurer and secretary, who has resigned. Mr. Robertson has been in the service of the American Locomotive Company since May 1, 1908. He was born in Brooklyn, January 10, 1885, and from November, 1900, until 1908 he was associated with the law office of Simpson, Thacher & Bartlett, New York.

Thomas E. Carliss, manager of the works of the Buffalo Brake Beam Company at Buffalo, N. Y., and Hamilton, Ont., died suddenly in Buffalo on July 9. Mr. Carliss had been in the brake beam business for about 30 years. He was at one time associated with the Central Brake Beam Company, at Detroit, for many years, afterwards becoming associated with the Monarch Brake Beam Company, when that company was started by Detroit capital. He had been in the service of the Buffalo Brake Beam Company for about six years.

The Locomotive Stoker Company, Schenectady, N. Y., has purchased the coal pusher business and taken exclusive licenses under all of the patents covering mechanical coal pushers for locomotive tenders owned by Ryan, Galloway & Co., Chicago, which, with the patents already controlled, will enable the Locomotive Stoker Company to add a complete line of mechanical coal pushers for all classes of locomotive tenders to its rapidly growing stoker business. Edward Ryan, of Ryan, Galloway & Co., has entered the employ of the Locomotive Stoker Company as mechanical expert.

The Columbus Bolt Works Company, Columbus, Ohio, has been incorporated with a capital stock of $660,000 to take over the business of the Columbus Bolt Works. J. R. Poste, formerly secretary and general manager of the Columbus Bolt Works, has been elected president, treasurer and general manager of the company; J. H. Poste, vice-president; T. A. Fleming, assistant treasurer, and H. A. Mason, secretary. The incorporators include J. R. Poste, J. H. Poste, W. F. Burdell, Beale Poste and F. H. Barrett. Julius Blum & Co., 510 West Twenty-fourth street, New York, have been appointed the eastern sales agents of the company.

John Havron, president of the Rogers Locomotive Works, Paterson, N. J., from 1901 to 1908, and more recently an officer

of the Walker & Bennett Car Seat Company, died in Jersey City on Saturday, July 25, at the age of 56, from cancer of the stomach. Mr. Havron started his career as a clerk in the employ of the old Rogers Locomotive & Machine Works in Paterson, N. J., in 1881. He gradually worked his way up to the position of secretary of the company, but left in 1893 to go to Chicago as the western representative of the Latrobe Steel Company, Latrobe, Pa. In 1901, when the Halloran and Smith syndicate bought the Rogers Locomotive Works, he returned to that company as its president and held that position until October 1, 1908, leaving at that time to go with the Latrobe Steel & Coupler Company, with office at Chicago.

Roy C. McKenna, of the McKenna Brothers Brass Company, Pittsburgh, Pa., has been elected president of the Vanadium-Alloys Steel Company, also of Pittsburgh. He succeeds E. T. Edwards. who has resigned to accept the presidency of the Latrobe Electric Steel Company, Latrobe, Pa., but who will remain a member of the board of directors of the Vanadium-Alloys Steel Company. Mr. McKenna brings to his new position the experience gained in the years he has been the head of the mechanical department of the McKenna Brothers Brass Company. He graduated from the Univercity of Pittsburgh in 1903 in electrical and mechanical engineering. Mr. McKenna's family has had considerable experience in the high-speed steel trade, having been identified with it ever since the year 1902.

R. C. McKenna

Charles B. McElhany, general manager of sales of the Cambria Steel Company, has been elected also a vice-president of that company. Mr. McElhany has been in the steel business for about 20 years, and in the service of the Cambria Steel Company for four years. His early years in the steel industry were spent in the employ of the Braddock Wire Company, the American Steel & Wire Company, the Union Steel Company and the Pittsburgh Steel Company. About nine years ago he entered the service of the Colorado Fuel & Iron Company, becoming assistant general manager of sales of that company. He then became assistant manager of sales of the Cambria Steel Company, in charge of the wire division. He was later appointed assistant general manager of sales, and on March 1 succeeded J. L. Replogle as general manager of sales.

C. B. McElhany

The Roberts & Schaefer Company, Chicago, has issued the following announcement: "We desire to announce that we have voluntarily released our control over the Holmen patents as relates to locomotive coaling plant equipment, and have canceled our agreement with Mr. Holmen. Two years ago we secured control of an improved design of elevating machinery which, while retaining all of the advantages of our previous equipment under the Holmen patents, entirely eliminates the bucket latches, closing springs, and trippers required by those patents. This change greatly improves the service and reliability. The results obtained after two years' operation of many representative plants, warrants us in making this form our standard, which we will hereafter employ in all of our locomotive coaling stations."

Henry S. Hawley, president of the Railroad Supply Company of Chicago, died on July 22, at his summer home in Saunderstown, R. I. He was born on August 12, 1851, at Bridgeport, Conn. From 1874 to 1883 he was actively engaged in bridge contracting and in promoting and constructing railroads, during which time he was identified with the Grand Trunk from Valparaiso, Ind., to Thornton, Ill., and also purchased at Master's sale the Chicago & Southern, now owned by the Grand Trunk. In 1883 he was the promoter of the Chicago & Wisconsin, which was leased to and completed by the Chicago, Wisconsin & Minnesota, and was president of the latter road during its construction from Chicago to Schlesingerville, Wis. This is now a part of the Minneapolis, St. Paul & Sault Ste. Marie. He was general agent and purchased a part of the right of way of the Chicago Great Western, and on its completion was appointed general agent in charge of traffic and leases. From 1890 to October, 1893, he was general agent in charge of traffic of the Chicago & Northern Pacific, and later was general agent and treasurer for the receivers of the same road. On July 1, 1897, he was made general agent and treasurer of the reorganized company, which was called the Chicago Terminal Transfer Company, and on February 1, 1899, he was appointed traffic manager, treasurer and assistant secretary of the same road. On June 1, 1902, he was elected president of the Railroad Supply Company.

H. S. Hawley

DUTY OF A PUMP.—There are different definitions for what is termed the duty of a pump, each giving a different estimate or value. The duty is sometimes defined as the weight in pounds of water raised through a vertical height of one foot for each 100 lb. of coal burned; or, more simply, the theoretical work (ft.-lb.) performed per hundredweight of coal burned under the boiler. It is observed that this definition is faulty, because it combines furnace and boiler efficiencies with that of the pump itself, besides estimating only the theoretical work performed, thus eliminating friction, which is often a most important factor. The true definition of duty in pumping is the actual work performed in a given time (ft.-lb.), per million B. t. u. delivered to the pump in the same time. Or, less frequently, the duty is estimated in foot-pounds of work per thousand pounds of dry saturated steam consumed.—*Coal Age.*

CATALOGS

Cold Storage System.—Bulletin No. 221 recently issued by the Link-Belt Company, Chicago, is a four-page leaflet descriptive of the Link-Belt patented circular storage system. The leaflet describes the system in detail, names its several advantages and contains illustrations of typical installations.

Wood Block Floors.—The Ayer & Lord Tie Company, Chicago, has recently issued a booklet on that company's interior creosoted wood block floors. The booklet discusses the several advantages of this type of flooring material and contains several illustrations of wood block floors laid in different kinds of shops.

Gas Engines.—Bulletin No. 34-X issued by the Chicago Pneumatic Tool Company, Chicago, is devoted to the Class A-G "Giant" gas and gasoline engines made by that company. Bulletin No. 34-U contains instructions for installing and operating "Chicago Pneumatic" Class N-SO fuel oil driven compressors.

Air Compressors.—Form No. 3,031 recently issued by the Ingersoll-Rand Company, New York, is devoted to the Ingersoll-Rogler Class FR-1 steam driven single stage straight line air compressors sold by that company. The company has also recently issued Form No. 4,034, relative to the Leyner-Ingersoll water drill.

Tools for Cutting Screw Threads.—This is the title of a catalog recently issued by the J. M. Carpenter Tap & Die Company, Pawtucket, R. I. The booklet, which is quite similar to the usual tap and die catalog, contains illustrations of the taps, dies, die-stocks, etc., made by the company, as well as tables of sizes and list prices.

Slotting Machines.—Catalog No. 49, recently issued by the Newton Machine Tool Works, Inc., Philadelphia, Pa., contains illustrations and specifications of the company's complete line of standard and special slotting machines and a number of illustrations of different designs of milling, boring, drilling and cold saw cutting off machines.

Car Heating Apparatus.—The Gold Car Heating & Lighting Company, New York, has recently issued circulars relative to that company's No. 804S positive lock coupler, its pressure regulator No. 1,014 and its up-to-date vapor system. The latter also shows how Gold's thermostatic control may be used in connection with the vapor system.

Electrical Testing Service.—The Electrical Testing Laboratories, Inc., New York, have recently issued an attractive loose-leaf booklet describing the equipment, organization and work of these laboratories. The service offered by the Laboratories includes the testing of instruments, electrical materials and machinery and tests of electric lamps.

Fabrikoid.—In a publication entitled "The Orange Book," the Du Pont Fabrikoid Company, Wilmington, Del., presents a number of exhibits which are extracts from proceedings or articles dealing with upholstery, all of which are used to show the superiority of Fabrikoid to the poorer grades of split leather for use in furniture upholstery, automobiles, etc.

Superheaters.—The Locomotive Superheater Company, 30 Church street, New York, has issued the fourth edition of its pamphlet entitled "The Use of Highly Superheated Steam in Locomotive Practice." This is devoted to a description of the Schmidt superheater, including data concerning its operation. A number of superheater accessories are also described.

Geared Locomotives.—The Heisler Locomotive Works, Erie, Pa., has recently issued catalogue No. 115, describing in detail the construction of the Heisler Geared Locomotives and classes of service for which they are suited. The various parts of the locomotive are described and information is included concerning the methods of laying out rough spur tracks.

Leather Goods.—The Du Pont Fabrikoid Co., Wilmington, Del., has just issued an attractive bulletin on Fabrikoid, which is made with a face of cotton cloth coated with a tough flexible material and embossed by steel plates or rolls to produce the appearance of any desired natural leather grain. The cover of this booklet is printed in colors and shows five different colors and grains of Fabrikoid. The booklet is well printed and illustrated.

Autogenous Welding.—In the Panama-Pacific International Exposition number of Autogenous Welding, the Davis-Bournonville Company, Jersey City, N. J., presents a number of articles descriptive of various large pipe line installations where the welding of the joints has been performed by its apparatus. The leading article deals with the installation of gas mains on the Exposition grounds at San Francisco, which were laid with welded joints.

Gears, Pinions and Trolleys.—The R. D. Nuttall Company, Pittsburgh, Pa., has recently issued catalog No. 12 relative to gears, pinions and trolleys for mine and industrial locomotives, and catalog No. 13 devoted to like equipment for electric railways. Each booklet contains illustrations and specifications of the apparatus described, there being included extensive tables giving the sizes and list price of the gears and pinions which may be obtained.

Heat Insulation.—A four-page folder recently issued by the Armstrong Cork & Insulation Company, Pittsburgh, Pa., is devoted to its high pressure covering for use on high pressure and superheated steam lines, boilers and other heated surfaces. This material is made up of a special form of silica of a minute cellular construction, mixed with asbestos. Owing to the cellular nature of the silicious material, it is said to be an exceptionally good heat insulator.

Passenger Car Couplers.—The McConway & Torley Company, Pittsburgh, Pa., has recently issued an eight-page booklet descriptive of the Pitt Passenger Coupler. In addition to an illustration of the coupler, the booklet also contains three drawings showing the coupler's great flexibility of curvature. Fig. 1 shows the limits of such flexible movement; Fig. 2, the extreme positions to which the couplers will adjust themselves in passing over a curve and tangent, and Fig. 3, the relative positions on a reverse curve.

Flexible Joints.—Barco Flexible Joints is the title on the cover of a loose-leaf booklet recently issued by the Barco Brass & Joint Company, Chicago. In this booklet are contained catalog No. 10 relating to blow-off terminal coach heating and washout nozzle connections; catalog No. 20 relating to roundhouse blower connections and specifications and the Barco automatic smokebox blower fitting; catalog No. 30 entitled "Barco Flexible Joints, Catalogue and Descriptive Bulletin," and catalog No. 40 relating to engine tender connections for steam, air and oil and car connections for steam and air.

Vertical Gas Engine.—The National Transit Company, Oil City, Pa., has recently issued bulletin No. 401, in which is illustrated and briefly described a vertical four-cycle, air cooled gas engine. A unique feature in the design of this engine is the use of the exhaust to induce the circulation of air through the cooling flanges on the cylinder. Bulletins Nos. 104 and 105, also recently issued, are devoted to a line of the Duplex direct acting type steam pumps, the former outside center packed and the latter of the packed piston type. These pumps are designed, for service from 200 lb. to 1,000 lb. pressure per sq. in.